



PROJECT ON MANAGING THE ATOM

LIMITING TRANSFERS OF ENRICHMENT AND
REPROCESSING TECHNOLOGY:
ISSUES, CONSTRAINTS, OPTIONS

BY: FRED MCGOLDRICK

WITH CONTRIBUTIONS FROM:

MATTHEW BUNN

MARTIN MALIN

WILLIAM H. TOBEY



HARVARD Kennedy School

BELFER CENTER for Science and International Affairs

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About the Author

Fred McGoldrick has extensive experience in nuclear non-proliferation and international nuclear policy fields. He held senior positions in the U.S. Department of Energy and the U.S. Department of State, where he negotiated U.S. peaceful nuclear cooperation agreements and helped shape U.S. policy to prevent the spread of nuclear weapons. He also served in the U.S. Mission to the International Atomic Energy Agency (IAEA) in Vienna. Since his retirement from the State Department, he has been a partner in Bengelsdorf, McGoldrick and Associates, LLC., an international consulting firm.

About the Project on Managing the Atom

The Project on Managing the Atom (MTA) is the Harvard Kennedy School's principal research group on nuclear policy issues. Established in 1996, the purpose of the MTA project is to provide leadership in advancing policy-relevant ideas and analysis for reducing the risks from nuclear and radiological terrorism; stopping nuclear proliferation and reducing nuclear arsenals; lowering the barriers to safe, secure, and peaceful nuclear-energy use; and addressing the connections among these problems. Through its fellows program, the MTA project also helps to prepare the next generation of leaders for work on nuclear policy problems. The MTA project provides its research, analysis, and commentary to policy makers, scholars, journalists, and the public.

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Project on Managing the Atom

Belfer Center for Science and International Affairs

Harvard Kennedy School

79 JFK Street; Malbox 134

Cambridge, MA 02138

Phone: 617-495-4219

Email: atom@harvard.edu

Website: <http://managingtheatom.org>

Cover Image: A 1984 photo of a cascade of gas centrifuges used to produce enriched uranium from a U.S. gas centrifuge plant in Piketon, Ohio
Photo Source: U.S. Department of Energy

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PREFACE

For several years, the Nuclear Suppliers Group (NSG) has been unable to reach a consensus on the adoption of revised guidelines for its members. The most contentious issue is how to strengthen restraints on the transfer of enrichment and reprocessing technologies in a manner that would be acceptable to all NSG members, and credible to the major exporting states and industry. In response to the ongoing impasse, Mary Alice Hayward, Director of Strategy at AREVA, Inc., suggested to us that an informed analysis and set of recommendations from the Project on Managing the Atom might help to catalyze a more productive discussion among key NSG members.

Faced with the prospect of generating a set of grounded, judicious, and novel recommendations, we turned to Fred McGoldrick who has worked on nonproliferation and focused on the NSG, both in and out of government, for more than 30 years. He did not disappoint. As the principal author of the report, McGoldrick emphasizes that the key to progress is keeping the limited problem of enrichment and reprocessing transfers in perspective, focusing on constructive outcomes instead of abstract principles, and strengthening international cooperation to deal with the most serious proliferation risks. McGoldrick makes a number of recommendations, which should help policy makers weigh their choices and resolve long-standing issues.

We thank Olli Heinonen, Mark Hibbs, Lawrence Scheinman, and Sharon Squassoni for their comments on an earlier draft of this report. The Center for Strategic and International Studies hosted a group of distinguished experts from several governments, nongovernmental organizations, and industry to discuss the report in an off-the-record setting and to help sharpen its recommendations. We thank CSIS for its hospitality. Finally, we thank AREVA, Inc., the John D. and Catherine T. MacArthur Foundation, and the Belfer Center for Science and International Affairs for their support of this project.

Matthew Bunn, Associate Professor of Public Policy, Harvard Kennedy School

Martin Malin, Executive Director, Project on Managing the Atom

William H. Tobey, Senior Fellow, Belfer Center for Science and International Affairs

SECTION I: INTRODUCTION

The diffusion of enrichment and reprocessing (E&R) technologies can increase the risk of the proliferation of nuclear weapons in several ways. First, enrichment and reprocessing facilities can produce nuclear materials – highly enriched uranium (HEU) and separated plutonium—that are directly usable in nuclear weapons. With such materials, a state could abrogate its nonproliferation commitments and produce a nuclear weapon within a short period of time. Given the legal ability of a party to the Treaty on the Non-Proliferation of Nuclear Weapons (NPT) to acquire enrichment and reprocessing facilities, produce weapon-usable materials and then withdraw from the Treaty after giving notice of its withdrawal three months in advance, a state would be free to develop nuclear weapons without, strictly speaking, violating the NPT.

Second, reprocessing plants are challenging and costly to inspect. The International Atomic Energy Agency (IAEA) faces technical and financial problems in ensuring timely detection of the diversion of significant quantities of weapon-usable materials to nuclear explosive purposes.

Third, it is difficult to detect, either through national technical means or international inspections or both, clandestine enrichment plants using such technologies as centrifuge or laser isotope separation.

Fourth, having enrichment or a reprocessing capability could increase the chance that nuclear weapons advocates could convince leaders of a state to develop nuclear weapons. Other states fearing such an outcome may be tempted to build “standby” capabilities of their own. (In this regard a strong distinction should be made with power reactors, for which there is little evidence that a decision to proceed with a nuclear energy program increases the probability of a state deciding also to pursue a nuclear weapons program.)

Finally, highly enriched uranium produced at enrichment plants and plutonium recovered from reprocessing facilities offer tempting targets for terrorists or other non-state actors.

For these reasons, restraining the spread of reprocessing and enrichment capabilities has long been an important nonproliferation objective. One of the most significant steps to achieve this objective was the agreement among the major nuclear suppliers to form the Nuclear Suppliers Group (NSG) in the late 1970s. The NSG put into place a common set of guidelines governing exports of nuclear materials, equipment and technology and agreed to exercise restraint in the transfer of sensitive nuclear facilities, technology and weapons-usable materials and to establish special controls on exports of E&R. Since then, the members of the NSG have exercised considerable restraint in the transfer of sensitive nuclear technologies to countries that lack such capabilities.

In recent years, however, certain developments have given rise to new concerns about the spread of enrichment and reprocessing technologies.

First, A.Q. Khan, when he was head of the Khan Research Laboratory in Pakistan, operated a successful illicit network that supplied sensitive nuclear technologies and equipment to help some states fulfill their nuclear weapons ambitions. This included the transfer of enrichment technology to North Korea, Iran and Libya. There have also been allegations that North Korea offered technology to other states, e.g., Iraq and Syria. Additional concerns have emerged that North

Korea may transfer, or may have already transferred, sensitive nuclear technology to other states.

In addition, fears of global warming and the security of supply of fossil fuels have led to a growing global interest in nuclear power. Some forecasts project an increase in nuclear power of 40-120% over the next two decades.¹ Many states that had no interest in nuclear energy in the past are developing plans to initiate civil nuclear power programs, and some have already begun to arrange for the purchase of reactors on the international market. Some of these countries are located in regions of political instability or areas of proliferation concern.

It is far from certain whether these projections and plans will be realized, particularly since the recent nuclear crisis in Japan may halt nuclear power plans in some countries or at least cause a major reconsideration. The Fukushima nuclear crisis may provide time to devise strategies that will allow for a growth in nuclear energy while minimizing the risks of proliferation. Nevertheless, there are apprehensions that a new interest in civil nuclear power may lead some states to seek enrichment and reprocessing technologies.

However real, this problem is a limited one so far. Very few states that do not already have such capabilities have shown any real interest in acquiring them over the near and mid-term.

In addition, most states with civil nuclear power programs do not pursue E&R capabilities. A country would have little economic or programmatic incentive to build E&R facilities to service a small number of nuclear reactors and would face serious technical challenges in developing E&R capabilities that are commercially viable.

Countries that have sought E&R capabilities have done so for a variety of reasons—to carry out entirely legitimate, peaceful programs (e.g., West Germany, the Netherlands, Japan); to remove doubts about the reliability of fuel supply from foreign sources (e.g., Eurodif, Urenco, Japan, Germany, India, Argentina, Brazil, and South Africa); to conserve nuclear fuel resources through reprocessing (e.g., Japan, France, UK, Russia, Germany, India); to achieve the prestige of possessing advanced, sophisticated fuel cycle facilities as a symbol of national achievement, and an important component of their national security (e.g., Argentina, Brazil, India, Iran); to satisfy the demands of an influential nuclear bureaucracy (as was especially true in the case of India); or to sell enrichment or reprocessing services on the international market (e.g., US, France, Germany, the Netherlands, UK, Russia, Argentina and Iran). Countries with nuclear power programs have made varying degrees of progress in finding a solution to the management of their spent fuel and nuclear wastes, but none have actually implemented a program for the permanent disposal of their spent fuel or nuclear wastes. Small countries face particularly formidable obstacles in locating suitable and politically acceptable sites for the disposal of nuclear wastes. Some countries

1. The 2009 update of the International Atomic Energy Agency's annual projections for the future of nuclear power forecast a low projection of an installed global nuclear power capacity of about 510 gigawatts (GW(e)) in 2030, a 40% increase over the 370 GW(e) currently installed in 2009. The IAEA's high projection foresees 810 GW (e), more than a doubling of present capacity. The Nuclear Energy Technology Roadmap, published in 2010 by the International Energy Agency (IEA) and the OECD Nuclear Energy Agency (NEA) estimates that almost one quarter of global electricity could be generated from nuclear power by 2050, making a major contribution to cutting greenhouse gas emissions. In the IEA scenario for a 50% cut in energy-related CO₂ emissions by 2050 (known as the "BLUE Map" scenario), on which the roadmap analysis is based, nuclear capacity grows to 1,200 GWe by 2050, providing 24% of global electricity at that time. Total electricity production in the scenario more than doubles, from just under 20,000 TWh in 2007 to around 41 000 TWh in 2050.

may look to reprocessing as a means of either reducing the quantity and toxicity of waste that will require disposal and/or conserving resources. They may also consider the use of plutonium as fuel in their nuclear power reactors. A few have also sought such E&R technologies to serve as part a dedicated nuclear weapons program (e.g., the U.S., UK, Russia, France, China, Israel, India, Libya, South Africa, Taiwan, Pakistan, Iraq, Iran, DPRK); to create an option for establishing a nuclear weapons capability on short notice (e.g., Brazil and the ROK); or to pursue both peaceful and military purposes (U.S., Russia, UK, France, China, Argentina, Brazil, India, South Africa).

Whatever the reasons for seeking E&R capabilities, the spread of these sensitive nuclear facilities to additional countries will, for the reasons outlined above, place considerable strains on the international nonproliferation regime.

In recognition of this potential danger, a number of proposals have surfaced in the last several years to limit the spread of enrichment and reprocessing technologies. These have included:

- **Offers of strengthened nuclear fuel assurances as incentives to countries to rely on the international market instead of acquiring their own enrichment and reprocessing plants.** A large number of proposals for improved fuel assurances have emerged in recent years, and a few have been actually put in place. The United States has established a strategic reserve of up to 17 tons of highly enriched uranium (HEU) that is no longer needed for military purposes and that is being blended down to low-enriched uranium (LEU) to help qualified states deal with disruptions in their nuclear fuel supply not related to their non-proliferation obligations. The U.S. Government attached several conditions to the provision of fuel from the U.S. reserve, including the requirement that the recipient would have to “voluntarily refrain” from domestic enrichment and reprocessing. The Russians have set up guaranteed reserves of 120 tons of LEU at its international nuclear center in Angarsk that could be supplied upon the IAEA’s request to ensure “reliable supplies of fuel for nuclear power plants when the market cannot do so.” This arrangement received the approval of the IAEA Board of Governors in December 2009. The Nuclear Threat Initiative (NTI), a private U.S.-based organization, announced in September of 2006 that it would contribute \$50 million to help create a low-enriched uranium stockpile under the auspices of the IAEA. Various IAEA Member States have pledged additional funds. While several members of the Non-Aligned Movement (NAM) delayed IAEA action on this proposal, the Board of Governors finally approved the NTI-proposed bank in December 2010, and the IAEA is now developing a detailed plan for the bank. More recently the Board of Governors approved a British proposal for enrichment bonds to enhance fuel assurances. The Russian fuel reserve, the IAEA fuel bank and the British enrichment bond scheme do not require potential recipients to forgo enrichment or reprocessing as a condition of supply from these reserves and supply arrangements.
- **Offer of participation in multinational enrichment and reprocessing facilities as an incentive to forgo national E&R facilities and to provide greater transparency and control of sensitive nuclear facilities.** This idea has been promoted by former Director General of the IAEA Mohamed ElBaradei but has not thus far generated great enthusiasm among those who possess such facilities. Some existing enrichment facilities are already multinational in nature, but participation is generally restricted to industrialized states. The only exception is Russia’s recent establishment of an international facility at Angarsk. The Angarsk arrange-

ment seems to have convinced Kazakhstan and Ukraine and possibly Armenia and Mongolia, but not Iran, to refrain from pursuing enrichment.

- **Arrangements for supplier states to take back spent fuel from consumer states (so-called “cradle-to-grave” fuel cycle services).** An offer to provide so-called cradle-to-grave services—including the supply of fresh fuel and removal of spent fuel—could provide a strong incentive for many countries to forego enrichment and reprocessing. In theory, such arrangements would offer greater assurance of timely delivery of reactor fuel and a clear disposition path for the used fuel, thereby, reducing the “energy security” incentive to enrich or reprocess to produce fuel indigenously. By providing for the return of spent fuel, such arrangements would undercut the argument that each country needs its own reprocessing capability in order to reduce the volume and toxicity of waste destined for a repository. To date, Russia is the only state that has offered to take back spent fuel (from Eastern Europe, Finland and Iran.) Moscow has also suggested that it would be willing to offer a package for fueling the reactors it exports, which would include provision of fresh fuel and return of the spent fuel to Russia with no requirement for return of the waste – a concept referred to as “fuel leasing.” For now, no state has shown an ability or willingness to host an international used fuel storage or disposal facility that would be available for spent fuel beyond its own fuel exports, though active discussions of such possibilities continue in several quarters. Hence, there do not appear to be realistic near-term prospects for implementing the cradle-to-grave idea, though this may change in the future, and there may be other ways in which supplier states can assist countries that are developing new nuclear programs to manage their use nuclear fuel.
- **Development and deployment of proliferation-resistant fuel cycle systems.** Various proliferation-resistant technologies are in the early stages of study and will require further research, development and demonstration. Some of the systems appear to offer only very modest barriers to proliferation compared to traditional approaches to enrichment and reprocessing.
- **Strengthening of supplier restrictions on the transfer of enrichment and reprocessing facilities beyond those contained in the existing guidelines of the Nuclear Suppliers Group.** Among other things, the current guideline calls for restraint in exports of E&R and encourages supplier or multinational involvement in transferred E&R facilities.

Purpose and Organization of the Report

Each of the above noted proposals, alone or in combination, offer the potential of discouraging the spread or reducing the risks of E&R. This report emphasizes the last of these proposals, namely how existing international mechanisms and norms could be strengthened or new ones created to restrain transfers of enrichment and recycling technology in ways that would be credible to governments, and industry. (However, the other proposals mentioned above will be examined in Section V, which describes options for an overall strategy for discouraging the spread of E&R.) Since 2004, the NSG has been discussing proposals to strengthen controls and restrictions on transfers of E&R technologies. As of November 2008, the NSG had developed a draft for a new criteria-based approach that would supplement the existing NSG criteria governing exports of E&R. However, NSG members have been unable to reach final agreement on these new criteria. The report will address possible ways to break this impasse in order to enhance controls and

restraints on the transfer of enrichment and reprocessing technology that are practical and credible. While it will give particular emphasis to forging a consensus among members of the NSG to update their national controls on the transfer of enrichment and reprocessing technology, it will also examine possible paths forward for gaining wider international acceptance of a regime that seeks to limit the dispersion of E&R.

Section II will describe the history of efforts to constrain the spread of enrichment and technology with particular emphasis on the NSG. It will also describe the current status of worldwide enrichment and reprocessing capabilities.

Section III will examine proposals over the past several years to upgrade the NSG guidelines on transferring enrichment and reprocessing and the obstacles and opposition they have faced in reaching consensus on new criteria for controlling transferring E&R.

Section IV will discuss the political and institutional constraints that will confront any attempt to forge a consensus on limiting the risks of enrichment and reprocessing. Any such effort must take into consideration not only the limitations of the NSG as an international institution but also the many divergent views and interests among states on this issue, including the divisions between developed and developing countries and those between nuclear-weapon states (NWS) and (NNWS) as well as the different interests between technology holders and non-holders who may wish to explore enrichment in the future.

Section V will explore the merits, disadvantages and feasibility of various options for breaking the current impasse among members of the NSG on adopting a new set of guidelines for controlling new transfers of E&R technology. In particular, the report will explore options for resolving the impasse in the NSG in ways that (a) would achieve the objective of limiting the proliferation risks these technologies pose; (b) be credible to the international community, governments, and industry; and (c) address the numerous political divisions that have so far blocked agreement among NSG members. This section will also identify and evaluate approaches that might be taken outside the NSG such as by the Group of Eight or the principal E&R technology holders to constrain the spread of enrichment and reprocessing technologies as well as complementary measures such as fuel assurances, multinational approaches to E&R and offers of cradle-to-grave fuel cycle services.

Section VI will offer some conclusions and recommendations.

SECTION II: ENRICHMENT AND REPROCESSING: THE STATE OF PLAY

The spread of reprocessing and enrichment capabilities became a major concern in the mid-1970s when a few nuclear exporting states began negotiating agreements to transfer enrichment and reprocessing technology to non-nuclear-weapon states like South Korea, Taiwan (then the Republic of China), Pakistan, Iran and Brazil. The states seeking these technologies were countries that had no commercial rationale for them. Some of them faced national security threats or had ambitions to acquire nuclear weapons or an option to do so. In response to this problem and to the Indian nuclear test of 1974 in particular, the United States took the initiative with other major nuclear exporters to form the NSG.² Although supplier countries Party to the NPT had already made the commitment to require international safeguards on exports of so-called “trigger list” items to non-nuclear weapon states, the objective of the NSG was to go beyond the safeguards requirement for nuclear transfers and to toughen export controls in general. In 1978, the major supplier states formed the NSG (now numbering 46 states)³ and published specific guidelines for the export of nuclear materials, equipment and technology, which have since been elaborated. (Appendix 1 contains INFCIRC/254/Rev.8/Part 1).⁴

These guidelines now require, among other things, that states importing nuclear materials, equipment and related technology provide assurances of peaceful, non-explosive-use and effective physical protection and accept comprehensive safeguards. The NSG members also established special guidelines for transfers of sensitive nuclear facilities, technology and weapons-usable materials. Specifically, paragraphs 6, 7 and 8 of the current NSG guidelines for transfers of enrichment and reprocessing provide for the following:

6. Suppliers should exercise restraint in the transfer of sensitive facilities, technologies and weapons-usable materials. If enrichment or reprocessing facilities, equipment or technology are to be transferred, suppliers should encourage recipients to accept, as an alternative to national plants, supplier involvement and/or other appropriate multinational participation in resulting facilities. Suppliers should also promote international (including IAEA) activities concerned with multinational regional fuel cycle centers.

7. For a transfer of an enrichment facility, or technology therefore, the recipient nation should agree that neither the transferred facility, nor any facility based on such technology, will be designed or operated for the production of greater than 20% enriched uranium without the consent of the supplier nation, of which the IAEA should be advised.⁵

2. The Indian test was perhaps the most important factor in the creation of NSG, since the test was carried out using material produced in facilities and using materials that were provided to India on the basis of bilateral peaceful use agreements with Canada and the United States.

3. The current members of the NSG are: Argentina, Australia, Austria, Belarus, Belgium, Brazil, Bulgaria, Canada, China, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Japan, Kazakhstan, Republic of Korea, Latvia, Lithuania, Luxembourg, Malta, Netherlands, New Zealand, Norway, Poland, Portugal, Romania, Russian Federation, Slovakia, Slovenia, South Africa, Spain, Sweden, Switzerland, Turkey, Ukraine, United Kingdom, and United States.

4. INFCIRC/254/Part.2, as amended, contains Guidelines for transfers of nuclear-related dual use equipment, materials, software and related technology.

5. In addition, the initial NSG guidelines contained a provision that the transfer of sensitive nuclear facilities, or major critical components thereof, or related technology, should require an undertaking (1) that IAEA safeguards apply to any facilities of the same type (i.e. if the design, construction or operating processes are based on the same

8. *Suppliers should, in order to advance the objectives of these guidelines and to provide opportunities further to reduce the risks of proliferation, include, whenever appropriate and practicable, in agreements on supply of nuclear materials or of facilities which produce material usable for nuclear weapons or other nuclear explosive devices, provisions calling for mutual agreement between the supplier and the recipient on arrangements for reprocessing, storage, alteration, use, transfer or retransfer of any material usable for nuclear weapons or other nuclear explosive devices involved.*

The NSG later adopted a “non-proliferation principle,” that is also relevant to transfers of E&R. Paragraph 10 of the guidelines reads as follows:

Notwithstanding other provisions of these Guidelines, suppliers should authorize transfer of items or related technology identified in the trigger list only when they are satisfied that the transfers would not contribute to the proliferation of nuclear weapons or other nuclear explosive devices.

In addition, paragraph 16 of the guidelines sets forth provisions for consultations among NSG members on matters connected to the implementation of the guidelines. The most important of these is paragraph 16 (b), which reads:

Suppliers should consult, as each deems appropriate, with other governments concerned on specific sensitive cases, to ensure that any transfer does not contribute to risks of conflict or instability.

In addition to the NSG guidelines themselves, individual suppliers developed their own national policies on the export of enrichment and reprocessing technologies.⁶

or similar physical or chemical processes, as defined in the trigger list) constructed during an agreed period in the recipient country and (2) that there should at all times be in effect a safeguards agreement permitting the IAEA to apply Agency safeguards with respect to such facilities identified by the recipient, or by the supplier in consultation with the recipient, as using transferred technology. This provision was designed to prevent a recipient state that did not have full-scope safeguards from importing sensitive nuclear technology (enrichment, reprocessing and heavy water production technology) under safeguards and then replicating another plant free of international safeguards. This requirement was subsequently deleted from the NSG Guidelines when the NSG adopted the requirement of full-scope safeguards as a condition of supply in 1992. Now that the NSG has exempted India from its full-scope safeguards requirement, the absence of a replication provision leaves a loophole in the guidelines as they apply to India.

6. In a notable reversal of previous policies, in the mid-1970s as a result of U.S. pressure both the French and German Governments adopted a policy not to transfer reprocessing technology. In December 1976, the French Government announced that it had decided no longer to authorize—until further notice—bilateral contracts pertaining to the sale to third countries of industrial facilities for spent fuel reprocessing. In June 1977 the German Government issued a declaration to the effect that it would not grant any license for the export of reprocessing facilities until further notice. Subsequent governments have reaffirmed this commitment. Although there has never been a similar pronouncement regarding enrichment, German government officials have indicated that it was safe to assume that what was said about reprocessing applies to enrichment too. However, IAEA inspections after the first Gulf War revealed that companies and individuals in Germany and other countries had supplied large quantities of dual-use equipment and technologies to the clandestine fuel cycle programs of Iraq. This led to major efforts to strengthen export controls in Germany and several other countries. U.S. policies and laws go even further than the European policies. The Nuclear Non-Proliferation Act of 1978 provides for tough conditions for the export of so-called sensitive nuclear technology, i.e., reprocessing, enrichment and heavy water production technology, and the U.S. as a matter of practice has not exported “sensitive nuclear technology” as defined in the Nuclear Non-Proliferation Act of 1978 (NNPA). These included all the requirements set out in section 123 of the Atomic Energy Act. U.S. foreign assistance law provides for the cutoff of economic and military assistance to countries that transfer or receive enrichment or reprocessing technology, and the NNPA provides for the termination of nuclear cooperation with any countries that enter into

Recent Transfers of Enrichment and Reprocessing Technology

Only a small number of transfers of reprocessing and enrichment technology for civil projects by NSG members have occurred in recent years. These have been overt and legal and have been made to states that already possess E&R capabilities.⁷ These have included the following:

- URENCO USA has constructed a centrifuge enrichment facility in the United States in accordance with an agreement between the U.S. and the European governments concerned. The URENCO technology is “black-boxed” i.e., no sensitive nuclear technology or restricted data is transferred to the U.S.
- Australia’s SILEX Systems Limited has transferred to General Electric the so-called SILEX technology, which uses lasers to separate uranium a technology developed by Australia to the United States. General Electric-Hitachi (GEH) Global Laser Enrichment (GLE) Uranium Enrichment Facility, a venture owned by GE, Hitachi and Cameco Corporation, has been formed to build the SILEX enrichment facility in the United States.
- On July 3, 2006, Areva and URENCO signed an agreement to establish the Enrichment Technology Company (ETC), a joint venture between Areva and Urenco in the field of uranium enrichment centrifuge technology. Areva owns a 50% equity stake in ETC. The so-called Cardiff Agreement provides for use by Areva of URENCO’s centrifuge enrichment technology, while excluding access to classified design information. The technology is being used in France’s Georges Besse II uranium enrichment plant.
- Areva is building an enrichment facility (Eagle Rock) in the United States using URENCO enrichment technology pursuant to an agreement under negotiation with the United States. However, enrichment technology, as in the case of the URENCO arrangement with LES, is “black-boxed,” i.e., it is transferred under conditions that do not permit or enable the transfer of classified enrichment technology.
- Russia has made centrifuge technology available to China under black-box conditions. The plant at Shaanxi is under IAEA safeguards; the plant at Lanzhou is eligible for safeguards, but the IAEA has not chosen to implement safeguards there.
- France and the United States have transferred some reprocessing technology to Japan. For example, in the case of the United States, the Department of Energy began cooperation in the 1990s with Japan in liquid metal reactor reprocessing technology. DOE made the determination, however, that this cooperation did not constitute “sensitive nuclear technology” as defined by the Nuclear Non-Proliferation Act of 1978 since Japan already possesses

an agreement for the transfer of enrichment or reprocessing materials and equipment. More recently section 104 (a) of the United States-India Nuclear Cooperation Approval and Nonproliferation Enhancement Act of 2008, which requires the President to certify that it is “the policy of the United States to work with members of the Nuclear Suppliers Group (NSG), individually and collectively, to agree to further restrict the transfers of equipment and technology related to the enrichment of uranium and reprocessing of spent nuclear fuel.” (Several enrichment technologies such as gaseous diffusion and centrifuge remain classified, while reprocessing technology has been declassified for many years.)

7. On the other hand, a number of countries were able to build enrichment and/or reprocessing facilities either on their own or through overt and covert acquisition of technologies on the international market, e.g., Argentina, Brazil, India, Iraq, Iran, and South Africa. These occurred either before the establishment of the NSG or as a result of illicit technology transfers. In addition, Taiwan, the Republic of Korea and Libya sought to acquire sensitive fuel cycle facilities but did not succeed in building full-scale facilities.

extensive reprocessing technology. The French have also explained that their reprocessing cooperation with Japan is not inconsistent with France's earlier declarations not to export reprocessing technology because it involves transfers to a country that already possess such technology. (In the past France played a major role in transferring technology to Japan for the construction of the Rokkasho plant and provided reprocessing technology to the Japan Nuclear Cycle Institute (JNC).

There were some troubling reports of efforts by Russia to transfer sensitive nuclear technology to Iran. In 1995 the U.S. became aware that, in addition to signing an agreement to complete the Bushehr reactors in Iran, then Minister of Atomic Energy Victor Mikhailov had agreed in a secret protocol to provide the Iranians with key fuel cycle facilities, including a uranium enrichment centrifuge plant. The U.S. immediately pressed the Russians to terminate all assistance to the Iranian nuclear program. While the Russians did not agree to cancel their lucrative reactor deal with the Iranians, they did commit to limiting their nuclear cooperation with Iran to the Bushehr reactor project during the period of its construction. Notwithstanding this commitment, Russian entities engaged in extensive cooperation with Iranian nuclear research centers, which is outside the bounds of the Bushehr project, including sensitive technologies with direct application to the production of fissile materials. Again in 2000, according to press reports, the United States intervened at a high level to pressure Russia not to proceed with plans to sell Iran laser technology the U.S. regarded as too costly for enrichment uranium for a commercial reactor and mostly suited to producing fissionable material for nuclear weapons. Since then, aside from Moscow's assistance to the Bushehr reactor project, Russian-Iranian cooperation has been sporadic with less evidence of official complicity.

Status of World-Wide Enrichment and Reprocessing Capabilities

At the present time, only a few states possess enrichment or reprocessing capabilities. Although several countries possess enrichment facilities, only the U.S., Eurodif (France and various other investors), Urenco (Germany, the Netherlands, UK), and Russia are commercial suppliers of enrichment services at the present time. China has two commercial-scale enrichment plants supplied by Russia to fuel its domestic civil nuclear reactors. Some countries, such as Argentina, India, Iran, Japan, and Pakistan have small enrichment capabilities. Brazil has plans to build an enrichment plant to meet its domestic reactor needs, and has an enrichment plant to produce naval fuel. The facilities in India and Pakistan are unsafeguarded, and many believe that Iran's enrichment facilities, even though subject to safeguards by the International Atomic Energy Agency (IAEA) are intended for a nuclear weapons option. The North Koreans recently revealed an enrichment plant to visiting American scientists, and there are indications that they may possess more than one such facility. Several nations have expressed an interest in acquiring a commercial enrichment capability at some time in the future, but there do not appear to be any states that have developed specific plans to build enrichment facilities in the near future with the possible exception of China. Many countries, however, have made clear that they do not intend to foreclose the opportunity to acquire such technology or to forego their rights to do so.

Similarly, only a few countries at the present time have large-scale commercial reprocessing facilities—France, Japan, Russia and the UK. France, the UK, and Russia provide reprocessing services to other countries, though in all three cases most of these contracts are coming to an end. Several

countries have unsafeguarded reprocessing plants that have been dedicated to producing plutonium for a nuclear weapons program (China, DPRK, India, Israel and Pakistan.) The United States has an unsafeguarded reprocessing facility at Savannah River. In addition to its military facilities, China has a pilot civilian reprocessing plant and is considering a large-scale facility. Russia operates reprocessing facilities that serve both military and civil purposes but has shut down, or is in the process of shutting down, most of its dual-use reprocessing plants. Russia has shown some interest in replacing its PUREX reprocessing plant with advanced closed fuel cycle facilities some decades from now. Beyond the major nuclear suppliers, Argentina has offered reprocessing services for Australian research reactor fuel. The Republic of Korea has been engaged in R&D on the nuclear fuel cycle, including the development of the so-called DUPIC process (Direct Use of spent PWR fuel in CANDU reactors) and pyroprocessing. In 2005, South Korea built a laboratory-scale Advanced Conditioning Processing Facility (ACPF) in the Irradiated Material Examination Facility of the Korean Atomic Energy Research Institute. India and Pakistan operate unsafeguarded reprocessing facilities for their nuclear weapons programs, although India has indicated its intention to place some new reprocessing facilities under IAEA safeguards in the future.⁸ In 2003 Iran revealed it had conducted plutonium reprocessing experiments in a hot cell at the Tehran Nuclear Research Center. The DPRK has an unsafeguarded reprocessing facility at Yongbyon.

Finally, countries such as Argentina, Brazil, Iran, Iraq and Pakistan successfully acquired not only nuclear materials and specially designed or prepared nuclear equipment and components for enrichment and reprocessing, but also dual-use items relevant to enrichment and reprocessing. In some of these cases, they were able to obtain such items from states that did not have adequate export control laws to regulate the transfer of such dual-use items.

8. This does not apply to recently constructed reprocessing plant at Tarapur that the Indians dedicated in January of 2011, but to future plants that will be placed under safeguards in accordance with the U.S.-Indian peaceful nuclear cooperation agreement. For the new Tarapur facility, see “PM dedicates Tarapur reprocessing plant to nation,” *The Times of India*, January 7, 2011.

SECTION III: STATUS OF CURRENT EFFORTS TO STRENGTHEN CONTROLS ON EXPORTS OF ENRICHMENT AND REPROCESSING

In response to revelations about the clandestine operations of the A.Q. Khan network, President Bush gave a speech on February 11, 2004, in which he proposed, among other things, that a) the world's leading nuclear exporters should ensure that states have reliable access at reasonable cost to fuel their civilian reactors, so long as those states renounce enrichment and reprocessing, and b) the members of the NSG should refuse to sell enrichment and reprocessing equipment and technologies to any state that does not already possess full-scale, functioning enrichment and reprocessing plants.

Following the President's speech the United States made a major diplomatic effort in the NSG to upgrade its guidelines on the transfer of enrichment and reprocessing materials, equipment and technology. After four years of failing to obtain support for a ban on E&R transfers, in 2008 the U.S. finally went along with efforts to adopt a more flexible, criteria-based approach, but the NSG has thus far been unable to reach agreement on such criteria. The fissures the U.S. proposal caused and subsequent efforts to establish a criteria-based approach reveal this issue to be a highly contentious and neuralgic one both in the NSG and in the wider international community.

The NSG Debate over New Controls on E&R Transfers

From the outset most NSG members rejected President Bush's proposal that the NSG ban the export of E&R technology to states that do not already possess full-scale, functioning plants. Rather than an outright prohibition on such transfers, most members favored a more flexible approach that would allow NSG members to transfer E&R to countries that met certain nonproliferation criteria. The criteria-based approach, which was put forward by the French and modified by other members, proposed, among other things, that suppliers should not authorize the transfer of enrichment or reprocessing facilities and equipment and technology, if the recipient does not meet certain minimum criteria. For example, the recipient would have to: be a party to the NPT and in full compliance with the Treaty; have a comprehensive safeguards agreement and an Additional Protocol in effect; be in compliance with its safeguards commitments; be implementing its responsibilities under UNSC Resolution 1540; have an agreement with the supplier state that includes assurances regarding non-explosive use, and effective safeguards in perpetuity; apply standards of physical protection based on current international guidelines; and adhere to international safety standards.

In addition, the criteria-based proposal called upon suppliers to "consider" the following factors:

- Whether the transfer would have a negative impact on the stability and security of the recipient state.
- Whether the recipient has a credible and coherent rationale for pursuing enrichment or reprocessing capability in support of civil nuclear power generation programs.
- If enrichment or reprocessing facilities, equipment or technology are to be transferred, suppliers should encourage recipients to accept, as an alternative to national plants, supplier involvement and/or other appropriate multinational participation in resulting facilities. (This language is already in the present NSG guidelines and would remain unchanged in the new criteria-based approach.)

While most NSG members were willing to work with this approach, some dissented. For example, Argentina and Brazil objected to the requirement of an Additional Protocol. Other states objected on other grounds.

The U.S. did not go along with the criteria-based approach initially and continued to insist on language contained in President Bush's 2004 speech. However, U.S. policy changed over time in response to strong and widespread objections to the Bush proposal. U.S. officials began to stress that the United States had no intention of infringing on the sovereign rights of consumer states to make their own decisions with respect to their nuclear energy policies and programs, and proposed that fuel assurances be available to any state that did not have an enrichment or reprocessing facility at the time it took advantage of the assurance (such as drawing fuel from an international fuel bank). The Bush Administration also made clear that states' choices on whether to forego sensitive facilities as a price for gaining new fuel guarantees were purely voluntary. Despite the softening of this approach to fuel assurances, however, the U.S. continued to take a firm line on E&R transfers, opposing the criteria-based approach and pressing the NSG to agree to ban the transfer of enrichment and reprocessing, except to countries already possessing such capabilities.

After many months of disagreement between the United States and other members of the NSG over this issue, in the spring of 2008, in a reversal of policy, the Bush Administration finally came to accept the criteria-based approach. In doing so, the U.S. proposed three additional criteria:

- The transfer must take place under conditions that will not permit or enable the replication of the technology (the so-called "black-box" approach).
- Suppliers would take into account whether a transfer would stimulate other countries in a region to seek their own SNT or whether it might lead to instability in the area.
- Suppliers will not transfer SNT to countries that have agreed to refrain from acquiring such technology. (This was aimed at the ROK and DPRK and their 1992 agreement in which they agreed not to possess enrichment or reprocessing facilities.)

The "black-box" approach proved to be the most contentious of the new U.S. proposals. Canada, in particular, opposed this criterion, since it wanted to keep open the possibility of buying centrifuge technology and then upgrading this technology over time in order to compete effectively in the international market.

As a counterproposal, the Canadians suggested at the NSG meeting in May 2008, that, instead of requiring black-boxing as a criterion for transferring SNT, suppliers would only have to consider the option of black-boxing the technology or operating a turn-key operation when deciding whether to transfer enrichment or reprocessing to states in good nonproliferation standing. Since the United States was unable to accept this counter-proposal, this issue blocked agreement for some time.

In addition, even though the ROK had reached an agreement in 1992 with the DPRK not to introduce enrichment and reprocessing technology to their respective territories, the ROK has maintained a strong interest in acquiring nuclear fuel cycle technologies and objected to the U.S.-proposed criterion that suppliers should not transfer SNT to countries that have already agreed to refrain from acquiring such technology.

Finally, and perhaps most surprisingly, other NSG members objected to the U.S.-proposed criterion that suppliers would have to take into account whether a transfer of SNT would stimulate other countries in a region to seek SNT capabilities or whether such a transfer might lead to instability in the region. The Netherlands and the Republic of South Africa took the position that all states in good nonproliferation standing are entitled to the peaceful benefits of nuclear energy, including enrichment and reprocessing. The Netherlands also said it could not go along with any negative criteria that denied states in good nonproliferation standing their rights to nuclear technology. On the other hand, both states indicated that they were prepared to go along with the objective criteria in the French proposal, e.g. whether a recipient state is not in violation of its nonproliferation obligations, adheres to the NPT, has a comprehensive safeguards agreement and the Additional Protocol in effect, etc. Both the Dutch and the Canadians opposed the earlier French-proposed criterion that suppliers should take into account “whether the recipient has a credible and coherent rationale for pursuing enrichment or reprocessing capabilities in support of civil nuclear power generation programs.” The Dutch and Canadians believed that this was a “negative” criterion and that only states that are engaged in “bad” behavior should be denied the right to SNT. By contrast, the U.S. called for this criterion to be made mandatory.

The “Clean Text” of November 2008

By November 2008, the NSG members were able to draft what became known as the “clean text” of the guidelines for the transfer of E&R technology. According to the “clean text”, NSG members would continue to abide by the existing NSG guidelines but also agree not to authorize transfers of E&R unless the recipient met certain so-called “objective” criteria. (See Appendix 2 for the exact language of the clean text.) These required that the recipient:

- Is a party to the NPT and is in full compliance with its obligations under that Treaty;
- Is implementing a comprehensive safeguards agreement and has in force an Additional Protocol or is implementing a regional arrangement approved by the IAEA which operates to achieve the same objective;
- Has not been identified by the IAEA as being in serious breach of its safeguards agreement, is not the subject of Board of Governors decisions calling upon it to take additional steps to comply with its safeguards obligations or to build confidence in the peaceful nature of its nuclear program, nor has been reported by the IAEA Secretariat as a state where the IAEA is currently unable to implement its safeguards agreement.
- Is adhering to the NSG Guidelines and has reported to the Security Council of the United Nations that it is implementing effective export controls as identified by Security Council Resolution 1540;
- Has concluded an intergovernmental agreement with the supplier including assurances regarding non-explosive use, effective safeguards in perpetuity, and retransfer;
- Has made a commitment to the supplier to apply mutually agreed standards of physical protection based on current international guidelines;
- Has committed to IAEA safety standards and adheres to accepted international safety conventions.

In addition to the above “objective” criteria, the “clean text” provides that NSG members would agree to consider other factors such as: whether E&R transfers are intended for peaceful purposes; whether the recipient has a credible and coherent rationale for pursuing an enrichment or reprocessing capability in support of civil nuclear programs; and whether the transfer would have a negative impact on the stability and security of the recipient state and general conditions of stability and security.

On the issue of “black-boxing” enrichment technologies, after extensive consultations, the U.S. and Canada reached an agreement that would limit the black-box criterion to existing enrichment technologies, but leave open the possibility of transferring new enrichment technologies without the black-boxing requirement. The clean text provides that, with respect to *existing* enrichment technologies, suppliers would

Avoid, as far as practicable, the transfer of specialized design, development, and manufacturing technology associated with such items; and

Seek from recipients an agreement to accept enrichment equipment, facilities, and technology under conditions that, at a minimum, do not permit or enable replication of the facilities.

For new enrichment technologies, the government concerned should propose arrangements in the NSG for the transfer of such technologies, and those arrangements should at a minimum be the same as the objective criteria specified above. The U.S. also agreed to accommodate South Korean objections and drop the criterion that suppliers should not transfer E&R to countries that have agreed to refrain from acquiring such technology. Argentine and Brazilian objections to requiring states to have the Additional Protocol in effect as a condition of receiving E&R were reportedly resolved when the NSG agreed to accept language that would allow E&R transfers to a recipient that either has the Additional Protocol in force or “has signed, ratified and is implementing a regional arrangement approved by the IAEA which operates to achieve the same objective by providing confidence in the peaceful nature of civilian nuclear programs.” This would allow Argentina and Brazil to receive E&R without having an Additional Protocol in effect. The regional arrangement that these states participate in is the Brazilian-Argentine Agency for Accounting and Control of Nuclear Materials. The safeguards applied by this agency are not the equivalent of the Additional Protocol. Unlike the Additional Protocol, these arrangements do not give the inspecting agency the right to additional information and access to facilities to detect the presence of undeclared nuclear activities.

Continued Impasse

Despite the progress made in drafting the clean text, the Budapest meeting of the NSG in June 2009 could not reach agreement on the issue of E&R transfers. Turkey objected to the NSG adoption of any so-called “subjective” criteria that suppliers would have to take into account in transferring enrichment and reprocessing to recipient countries. In particular, the Turks rejected the proposed criterion that a supplier would have to consider whether the transfer of enrichment and reprocessing would stimulate other countries in a region to seek similar capabilities or whether such a transfer might lead to instability in the region. They felt that some might regard Turkey as being in an unstable area. Ankara said that it would be prepared to go along with the objective criteria in the clean text but opposed the NSG adoption of any “subjective” criteria. They stated

that only states that are engaged in “bad” behavior should be denied the right to enrichment and reprocessing technology. The Turks also did not support the black-box criterion and took the position that there should be no NSG guideline that would deny a state access to enrichment or reprocessing technology if it were in full compliance with its nonproliferation obligations as spelled out above.

South Africa continued to take the position that the NSG should require only adherence to the NPT as a condition of supply. As a result of these various differences, the NSG members were not able to agree on new criteria for the export of enrichment and reprocessing at the 2009 meeting in Budapest. However, they did agree to try again to work on new formulations that would be acceptable to all 46 members of the NSG.

When the NSG met in New Zealand in June 2010, Turkey continued its objections to the NSG’s adoption of any criteria that would deny states that are in compliance with their nonproliferation obligations access to enrichment and reprocessing technology. Ankara specifically opposed the incorporation of the black box criterion in the NSG guidelines.

However, the Government of Turkey now seems have overcome its objections and appears ready to go along with the clean text with a few minor modifications.

This has left South Africa as the only holdout to agreement on the draft of the clean text as it opposes any criteria for E&R transfers that go beyond the NPT. The South Africans reportedly voiced their objection to the draft criterion that a recipient would have to have an Additional Protocol to its safeguards agreement with the IAEA as a condition for supply of E&R, since it regards the Additional Protocol as “voluntary” and not required by the NPT.

Since the NSG operates on the basis of consensus, the group was unable to adopt a new guideline on E&R, and the NSG public statement on the meeting said only “Participating Governments agreed to continue considering ways to further strengthen guidelines dealing with the transfer of enrichment and reprocessing technologies.”

In an interesting aside, the 2010 NSG meeting saw another player emerge in the discussion of the “clean text” – namely India, a non-member of both the NSG and the NPT. As noted, one of the criteria in the clean text would ban the transfer of E&R to any state that is not party to the NPT. India would, therefore, not be eligible for obtaining such technology from NSG members, if the group were to adopt the clean text. In the weeks preceding the Christchurch meeting, India reportedly pressed Russia, France and also Germany to defer an NSG decision on this question. Official Indian sources told the press that New Delhi sent a clear signal to its friends and partners that the NSG’s September 2008 exemption of India from its comprehensive safeguards guideline must remain unaffected by any changes adopted, since that decision was the product of mutual undertakings by both the NSG and India. For India that means that New Delhi should now be eligible for full nuclear cooperation in all aspects of the fuel cycle, including E&R. The inability of the NSG to adopt the clean text was, therefore, welcomed by India, but in July 2010, the Group of Eight (G-8) issued a statement that its members would abide by the clean text at least for the coming year. (For a discussion of the G-8 handling of the E&R issue, see Section V below.)

SECTION IV: CONSTRAINTS: POLITICAL AND INSTITUTIONAL

The proposals to limit the spread of E&R technology have encountered significant obstacles that stem from the political and commercial interests of states with existing or aspiring nuclear power programs. They have provoked angry charges of discrimination and a spirited defense of the rights of non-nuclear-weapon states and developing countries to pursue peaceful nuclear programs and to make their own nuclear fuel cycle choices. The reactions have occurred in both the NSG and the wider international community. These divisions may continue to affect the ability of the NSG to reach agreement on the conditions for transferring E&R and to forge a broader international consensus on an appropriate approach to reconcile the need to reduce the proliferation risks of the dispersion of E&R technologies with the rights of states to pursue peaceful nuclear programs. In addition, any attempt to strengthen controls on transfers of E&R must take into account the fact that the NSG operates (as do other international fora) under certain institutional constraints and weaknesses as well as image problems with non-NSG members, especially with developing countries.

This section describes in more detail the political constraints and controversies surrounding recent initiatives to upgrade export controls on E&R and identifies some of the key limitations of such institutions as the NSG in implementing such controls

Political Controversies and Constraints

Proposals to limit the spread of E&R technology have been the subject of considerable controversy within the NSG itself, the IAEA Board of Governors, the NPT Review Conference, and in bilateral negotiations that the United States has conducted with individual states.

Disagreements within the NSG

The NSG is composed of the five NPT nuclear-weapon states and forty-one non-nuclear weapons states party to the NPT. It includes advanced industrialized countries and nations in varying stages of economic development. Some of its members have major nuclear programs, including commercial enrichment and reprocessing facilities, while others have only small programs but have aspirations to build new nuclear facilities. Others possess uranium resources and want to preserve the option of constructing enrichment plants in order to produce value added to such resources. Some of the members are interested in acquiring E&R capabilities or want to protect their options to do so in the future. Members of the group do not necessarily assign the same priorities to non-proliferation or to the conditions that the NSG should apply to exporting such technology.

Since discussion of strengthening export controls on E&R began in 2004, a number of NSG members, including Argentina, Brazil, Canada, South Korea, Spain, Switzerland, Turkey and South Africa registered opposition to one or more of the proposed new criteria for the transfer of E&R. The idea of “black-boxing” enrichment technology, in particular, ran into varying degrees of opposition from both developing and developed members of the NSG, all of whom viewed the proposal as a threat to their right or opportunity to employ enrichment technology. As noted above, the Canadians were reluctant to accept the black-box concept because they believed it would place undue constraints on their commercial nuclear interests, namely keeping open the option of importing centrifuge technology and upgrading it over time to compete effectively in the international market.

Although they eventually came around to support the clean text, Spain and Switzerland were also uncomfortable with the black-box criterion. They took the position that, if they were ever to become a member of Urenco, they should have access to the Urenco centrifuge technology. By the time of the June 2009 NSG meeting in Budapest, however, most NSG members seemed prepared to go along with the black box idea. Perhaps progress on this issue was facilitated by the fact that exporting enrichment technology under a “black-box” approach has, in fact, been the common international practice in recent years. As pointed out earlier, the Russian transfer of centrifuge technology to China, the Urenco transfer of technology to AREVA and URENCO USA in the U.S. and the proposed construction of the Eagle Rock Areva plant in the U.S. have taken place or are to take place under commercial “black-box” conditions, implying that there is no transfer of classified enrichment technology⁹ Whether such arrangements, which include review by the Nuclear Regulatory Commission and access to design knowledge by URENCO employees who are U.S. citizens, would be suitable in all other contexts is questionable. How “black” a box in the real world is will depend on a number of factors, including the type of technology, the specific conditions required by the supplier and the effectiveness of the controls established to prevent the transfer of classified technology.

Another major dispute preventing the adoption of the clean text in the NSG concerned the so-called “subjective criteria.” Turkey took particularly strong objection to the “subjective” criterion that suppliers would have to consider whether the transfer of enrichment and reprocessing would have a negative impact on the stability and security of the recipient state and general conditions of stability and security. Ankara was concerned that suppliers would regard Turkey as being located in a politically unstable area. However, as noted, Turkey has reportedly overcome its objections to the clean text and is prepared to go along with the document with a few minor modifications.

An additional issue was South Africa’s insistence that the NSG should only require adherence to the NPT as a condition of supply of E&R. This view is somewhat surprising since the basic rationale of the NSG from its founding was the recognition that the NPT requirements for IAEA safeguards and no explosive use assurance were insufficient to provide effective controls on nuclear exports. Nonetheless, the South African position is reflective of a wider view held by many NPT parties that any restrictions on nuclear cooperation that go beyond the NPT are inconsistent with Article IV of that Treaty. Article IV of the NPT provides that:

1. Nothing in this Treaty shall be interpreted as affecting the inalienable right of all the Parties to develop research, production and use of nuclear energy for peaceful purposes without discrimination and in conformity with articles I and II of this Treaty.

2. All the Parties to the Treaty shall undertake to facilitate, and have the right to participate in, the fullest exchange of equipment, materials and scientific and technological information for the peaceful uses of nuclear energy. Parties to the Treaty in a position to do so shall also cooperate in contributing alone or together with other States or international organizations to the further development of the applications of nuclear energy for peaceful purposes, especially in the territories of non-nuclear-weapon States Party to the Treaty, with due consideration for the needs of the developing areas of the world.

9. An exception to this general practice may be the General Electric purchase of Silex technology from Australia. Unlike centrifuge technology, Silex technology apparently cannot be easily black-boxed, since the lasers involved in a Silex plant need a great deal of tending to by the operator.

The incorporation of this article in the NPT was part of a basic bargain that was essential to the success of the negotiations and the entry into force of the Treaty. The philosophy underlying this provision was that, if non-nuclear weapon-state parties to the Treaty agreed to forswear the manufacture acquisition of nuclear weapons and accept IAEA safeguards on all their peaceful nuclear activities, they should be assured the right to obtain the full benefits of the peaceful uses of nuclear energy. Several parties to the Treaty take the position that Article IV implicitly entitles any Party in good standing to acquire its own independent fuel cycle, including enrichment and reprocessing, so long as it fully abides by the Treaty's provisions. U.S. statements arguing that the treaty does not provide such a right only exacerbated the political controversy.

It bears emphasis that opposition to the proposals on E&R transfers came not just from developing countries but from advanced states and even from states with a long history of strong support for the nonproliferation regime, such as Canada and the Netherlands, whose opposition stemmed not only from commercial interests but from concerns that states compliant with the NPT obligations should not be denied enrichment and reprocessing options.

Resistance from the Non-Aligned Movement

Thus the debates within the NSG revealed differences over economic and commercial interests among various members as well as conflicting views over “subjective” criteria that went beyond compliance with the NPT and IAEA safeguards obligations. These various differences were also expressed, and perhaps more clearly and strongly, in broader international fora. In particular, the Non-Aligned Movement (NAM) voiced sharp and uncompromising protests at the IAEA Board of Governors and the NPT Review Conference. For the NAM, the issue has been one of discrimination and what they view as a denial of rights that are specifically set out in the NPT to the peaceful uses of nuclear energy.

In a paper submitted to the June 2009 meeting of the Board of Governors, the NAM made a tough statement on the proposal for an international fuel bank. This statement is also highly relevant to the efforts of the NSG to restrict transfers of enrichment and reprocessing because it challenges the whole idea of discouraging or limiting trade in sensitive nuclear technologies.

The Group, in principle, reiterates its strong rejection of any attempts aimed to discourage the pursuit of any peaceful nuclear technology on the grounds of its alleged “sensitivity.”

The Group is of the view that any proposal for the assurance of supply should not be designed in a way that discourages States from developing or expanding their capabilities in the area of the nuclear fuel cycle, nor to hamper research and development and international cooperation in the field of peaceful nuclear activities. The Group reiterates that it is the sovereign right of all States without discrimination to develop or expand their capabilities in the field of peaceful nuclear activities including the nuclear fuel cycle.

The Agency should not lose its main focus on promoting the peaceful uses of nuclear science and technology, including national fuel cycle capabilities, through national capacity building and transfer of technology.

The NAM took a similar tough stance at the NPT Review Conference in May 2010, insisting that the final document contain no language restricting nuclear transfers.

The NAM Working Paper at the 2010 NPT Review Conference made the following statements:

Para. 42. To emphasize that the Treaty does not prohibit the transfer or use of nuclear equipment or material for peaceful purposes based on their “sensitivity”, and only stipulates that such equipment and material must be subject to full-scope IAEA safeguards.

Para. 43. To reiterate that the issue of assurances of nuclear fuel supply is a very complex and multi-dimensional concept with technical, legal, commercial and economic implications. In order to reach a consensual conclusion, it is premature for this issue to be considered before undergoing extensive, comprehensive and transparent consultations. In this context, reject, in principle, any attempts aimed at discouraging certain peaceful nuclear activities on the grounds of their alleged “sensitivity”; and emphasize that any ideas or proposals, pertaining to the non-proliferation of any peaceful nuclear technology, which are used as a pretext to prevent the transfer of such technology, are inconsistent with the objectives of the NPT.

The NAM has made similar assertions at previous NPT Review Conferences. As expected, the final document of the 2010 NPT Review Conference reaffirmed the inalienable rights of parties to the Treaty to nuclear energy for peaceful purposes. It also stated that “each country’s choices and decisions in the field of peaceful uses of nuclear energy should be respected without jeopardizing its policies for international cooperation agreements and arrangements for peaceful uses of nuclear energy and its fuel cycle choices.”

The final document called upon all State parties, acting in pursuance of the objectives of the Treaty, to observe the legitimate right of all State parties, in particular developing States, to full access to nuclear material, equipment and technological information for peaceful purposes and to facilitate transfers of nuclear technology and materials, and international cooperation among States parties in conformity with Articles I, II, III and IV of the Treaty and “eliminate in this regard any undue constraints inconsistent with the Treaty.”

Bilateral U.S Peaceful Nuclear Cooperation Agreements

Recent U.S. efforts to conclude bilateral peaceful nuclear cooperation agreements with certain states have also raised misgivings and objections from developing countries about how far the U.S. is willing to go in restricting enrichment and reprocessing. In the 2009 U.S peaceful nuclear cooperation agreement with the United Arab Republic (UAE), the U.S. insisted that the UAE assume the obligation not to possess enrichment and reprocessing technologies. Article 7 of the U.S.-UAE agreement explicitly provides that,

The United Arab Emirates shall not possess sensitive nuclear facilities within its territory or otherwise engage in activities within its territory for, or relating to, the enrichment or reprocessing of material, or alteration in form or content, (except by irradiation or further irradiation or, if agreed to by the parties, post-irradiation examination) of plutonium, uranium 233, high enriched uranium, or, if agreed to by the parties, irradiated source or special fissionable material.

This is the first time that a cooperating partner of the United States has made a legal commitment in a peaceful nuclear cooperation agreement to forego enrichment and reprocessing. The United States has sought to establish the U.S.-UAE agreement as the model for such programs in peaceful nuclear cooperation agreements with other states in the Middle East. In the agreed minute the

U.S. committed to give the UAE a most favored nation treatment in the event it were to negotiate an agreement with another state in the Middle East that contained more favorable terms.¹⁰

The Obama Administration has sought to persuade Jordan to agree to the same commitments found in the UAE agreement to abstain from domestic enrichment and reprocessing.

Khaled Toukan, the head of the Jordan Atomic Energy Commission told the press that,

We believe in the universality of the NPT. We do not agree on applying conditions and restrictions outside of the NPT on a regional basis or a country-by-country basis. But I think we still don't have common ground. They started to understand our viewpoint, but still (there is) no common ground.¹¹

Toukan made clear that Jordan will not follow the example of the UAE in relinquishing its NPT rights to enrichment and reprocessing, stating that, "The United Arab Emirates has relinquished all its NPT rights to sensitive nuclear technology indefinitely. Why should we give up our rights?" He added that Article IV of the NPT stipulates that, "all countries have the right to full utilization of peaceful nuclear energy, research and development." He added that, "We are sticking and adhering to the NPT, and (we want) full rights and privileges under the NPT."

Thus whether Jordan will be willing to accept restrictions comparable to those in the U.S.-UAE agreement remains to be seen.

The United States will likely face resistance if it seeks to require that the Republic of Korea forswear enrichment and reprocessing as it negotiates a new peaceful nuclear cooperation agreement with the Republic of Korea (ROK) to replace the existing agreement that expires in 2014. The ROK is expected to press the United States to provide the same kind of advance, long-term consent to reprocessing¹² used nuclear fuel subject to the new U.S.-ROK agreement as it has given in the cases of its agreements with Japan and EURATOM. However, the U.S. has long opposed reprocessing on the Korean Peninsula. Moreover, Under Secretary of State Ellen Tauscher stated in written answers to the Senate Foreign Relations Committee, in connection with her nomination hearings, that, "the existence of a reprocessing plant in the Republic of Korea would be inconsistent with the commitments made in the 1992 Joint Declaration." That declaration provides that: "The South and the North shall not possess nuclear reprocessing and uranium enrichment facilities." Now the North Koreans have both technologies. The South Koreans, on the other hand, are likely to press the point that North Korean reprocessing and enrichment, and its nuclear weapons tests, both constitute a violation of the two countries' 1992 denuclearization agreement. This, they

10. The agreed minute to the U.S.-UAE agreement provides, "The Government of the United States of America confirms that the fields of cooperation, terms and conditions accorded by the United States of America to the United Arab Emirates for cooperation in the peaceful uses of nuclear energy shall be no less favorable in scope and effect than those which may be accorded, from time to time, to any other non-nuclear-weapon State in the Middle East in a peaceful nuclear cooperation agreement. If this is, at any time, not the case, at the request of the Government of the United Arab Emirates the Government of the United States of America will provide full details of the improved terms agreed with another non-nuclear-weapon State in the Middle East, to the extent consistent with its national legislation and regulations and any relevant agreements with such other non-nuclear weapon State, and if requested by the Government of the United Arab Emirates, will consult with the Government of the United Arab Emirates regarding the possibility of amending this Agreement so that the position described above is restored."

11. Ibid.

12. In this case, the ROK is interested in developing and deploying pyroprocessing.

will argue, renders null and void the South Korean commitment in that agreement not to possess enrichment or reprocessing capabilities and further that the ROK has the right to engage in reprocessing as long as it is abiding by its NPT obligations. The ROK will also likely make the case that it has the right to engage in reprocessing as long as it is abiding by its NPT obligations.

The State of Play: Evolution of U.S. Policy—Language, Policies, and Laws

The United States initiated the most recent efforts to restrict the transfers of enrichment and reprocessing technology beginning with President Bush's speech of February 11, 2004. This speech contained highly restrictive and provocative language as it called for a ban on the sale of E&R to any state that did not already possess full-scale, functioning enrichment and reprocessing plants –thus explicitly proposing a highly discriminatory regime of nuclear haves and have-nots. It also suggested that improved fuel assurances be offered only to those states that renounce enrichment and reprocessing, thus calling on states to surrender what they consider their sovereign rights as states as well as the rights guaranteed them by the NPT.

President Bush's speech was followed by additional initiatives and statements that further fanned the flames. The terminology used to describe the U.S.-initiated Global Nuclear Energy Partnership (GNEP) proposed dividing the world into so-called “fuel-cycle states” and “reactor states”—the latter category to consist of states that did not possess enrichment or reprocessing capabilities. A major objective of GNEP was to have a limited number of countries –so-called fuel cycle states, provide nuclear fuel to other states for reactors to generate electricity, and then remove the fuel for reprocessing or disposition. Non-nuclear-weapon states and developing countries saw this as an unconcealed effort to divide the nuclear world into two separate but unequal parts. Perhaps most provocative were the remarks of John Bolton, then Under Secretary of State for Arms Control and International Security, to the NPT Preparatory Conference in 2004 in which he stated rather categorically that, “The Treaty provides no right to such sensitive nuclear technologies.” Non-nuclear-weapon states viewed this kind of language as a renunciation of the basic bargain of the NPT and as a tactic to widen the divide between nuclear-haves and have-nots.

Thus the language used to describe these U.S. proposals produced widespread perceptions that the United States was trying to establish a new global fuel cycle regime that would be highly discriminatory in nature, intended as an effort to divide the world into nuclear haves and have-nots, and designed to deprive NPT parties of their rights to the nuclear fuel cycle.

In response to these reactions, the Bush Administration eventually began to take a more flexible position that, consumer states could take advantage of new fuel supply assurances as long as they had not built enrichment or reprocessing facilities, without renouncing any of their rights. President Barack Obama tried to sound even more open-minded about this issue in his nonproliferation speech in Prague on April 5, 2009, emphasizing the rights of states to peaceful nuclear energy. He stated,

And we should build a new framework for civil nuclear cooperation, including an international fuel bank, so that countries can access peaceful power without increasing the risks of proliferation. That must be the right of every nation that renounces nuclear weapons, especially developing countries embarking on peaceful programs. And no approach will succeed if it's based on the denial of rights to nations that play by the rules.

Under Secretary of State for Arms Control and International Security Ellen Tauscher delivered remarks at Stanford on January 19, 2010, that went even further and were harshly critical of the Bush Administration's policy toward discouraging the spread of enrichment and reprocessing. She stated rather bluntly,

The previous administration proposed to ban these technologies for states that do not already possess them. The problem was that all other countries opposed this approach because they viewed it as an infringement on their sovereignty and on their Non-Proliferation Treaty rights to peaceful nuclear technology. Moreover, the very insistence that others not obtain such capabilities increased demand for them by creating the impression that we are seeking to establish a suppliers' cartel. Instead of reassurance, this had the opposite effect.

As President Obama said in Prague, "no approach will succeed if it's based on the denial of rights to nations that play by the rules." So the administration is focusing on creating incentives for states considering nuclear energy to choose not to pursue sensitive fuel cycle technologies.

Thus the U.S. has made deliberate efforts to lower the temperature of the debate over restrictions on E&R transfers by tempering the rhetoric that implied the establishment of a discriminatory regime and emphasizing the rights of states to peaceful nuclear energy as long as they are abiding by their nonproliferation objectives.

However, the efforts to introduce more moderate language in U.S. declaratory policy have been compromised to some extent both by the U.S. policy to press countries in the Middle East to make binding commitments to abstain from acquiring E&R and by certain actions by the U.S. Congress. The Henry J. Hyde United States-India Peaceful Atomic Energy Cooperation Act of 2006 (Public Law 109-401) required the President to make a determination as a condition of initiating nuclear cooperation with New Delhi that "India is working with and supporting United States and international efforts to prevent the spread of enrichment and reprocessing technology to any state that does not already possess full-scale, functioning enrichment or reprocessing plants." The Congress used similar terminology again in section 104 (a) of the United States-India Nuclear Cooperation Approval and Nonproliferation Enhancement Act of 2008, which requires the President to certify that it is "the policy of the United States to work with members of the Nuclear Suppliers Group (NSG), individually and collectively, to agree to further restrict the transfers of equipment and technology related to the enrichment of uranium and reprocessing of spent nuclear fuel."

In addition, The Foreign Affairs Committee of the U.S. House of Representatives recently marked up a bill that would make the U.S.-UAE peaceful nuclear cooperation agreement a model for all future U.S. agreements, i.e., requiring all future cooperating partners to undertake a legal commitment not to acquire enrichment and reprocessing technologies.

Thus, while the U.S. has made strides to moderate the debate on this issue, the original initiatives undertaken by the U.S., the U.S. approach to bilateral agreements in the Middle East and perhaps with the ROK and others, and legislation by the U.S. Congress have had a lasting effect. As a result, suspicions about U.S. intentions remain strong, as does resistance to proposals to restrict cooperation in enrichment and reprocessing technologies. As the 2010 NPT Review Conference

debate revealed, there remain sharp divisions on this issue, and the NAM as well as other NNWS remains highly sensitive about restrictions on nuclear trade.

Institutional Constraints

Devising proposals on acceptable means of limiting the risks of enrichment and reprocessing has to take into account not only the political divisions and obstacles in the NSG and the international community on this contentious issue but also the fact that the NSG suffers from a number of institutional weaknesses and deficiencies as well as image problems.

Implementation by Individual Members

The NSG is not an institution that approves or disapproves individual exports of nuclear materials, equipment or technology or nuclear-related dual-use items. Rather, the NSG establishes a set of guidelines for controlling nuclear trade, and each member decides for itself how to interpret and implement its export policies in accordance with the guidelines. Member states have had differences in interpreting and applying the guidelines. While the NSG guidelines call upon the members to consult on matters connected with their implementation, and the NSG meets to discuss specific cases and violations of supplier-recipient understandings through regular or diplomatic channels, it has no mechanism to resolve disputes about differing interpretations of the guidelines. For example, both Russia and China have creatively interpreted the guidelines on grandfathering and safety exceptions in order to promote their own commercial and/or strategic interests in India and Pakistan.¹³ There is no guarantee that all NSG members would interpret the concept of black-boxing enrichment technology in the same way or in accordance with common and effective standards.

No Legal Obligations

The NSG is an informal international institution in which members make that political pledges rather than binding legal obligations to implement the guidelines. The NSG has no means of sanctioning members who violate their norms. Thus there was no mechanism to stop or sanction Russia from exporting nuclear material or equipment without requiring full-scope safeguards to India, before the NSG agreed to make an exception for India. This issue is now arising again with

13. When the NSG adopted the comprehensive safeguards requirement in 1992, it applied only to prospective commitment, not to previous supply commitments which were “grandfathered.” Russia has engaged in a number of dubious export practices. In 1988 Russia concluded a general peaceful nuclear cooperation agreement with India prior to the NSG adoption of the full-scope safeguards requirement in 1992. This was a general legal framework for cooperation and contained no commitments to supply nuclear materials, equipment and technology. Russia claimed this agreement as a “grandfathered contract” that exempted its nuclear cooperation with India from the NSG’s full-scope safeguards requirement. Russia has exploited this situation to sell India a number of its nuclear power plants requiring only safeguards on the exported items. The United States and a few other member states raised questions about this cooperation but to no avail. In addition, in 2001 Russia exported low-enriched uranium to India for fueling the Tarapur reactor also without requiring full-scope safeguards. Even though India was not a party to the NPT and did not accept full-scope safeguards, Russia justified its action as falling within the safety exception clause of the NSG Guidelines. Most members regarded this export as violating Russia’s commitment to the full-scope safeguards guideline. However, even though many members criticized this Russian export, the NSG has no established mechanisms to question the validity of interpretations of the guidelines or violations of the guidelines. More recently China appears on the verge of supplying Pakistan two new reactors apparently on the dubious ground that these are covered by the grandfather clause.

respect to proposed Chinese reactor sales to Pakistan, which would again run contrary to the requirement for full-scope safeguards.

Consensus Needed for Changes to Guidelines

The NSG requires a consensus about every change to the guidelines, meaning that that a single member can block new reforms. However, eliminating consensus as the basis for decision-making seems highly unlikely.

Lack of Universality

The NSG has only 46 members. Some states outside the NSG have the capability to provide significant assistance to enrichment and reprocessing programs but do not have the legal or regulatory regimes, the resources in place or, in some cases, the will to implement effective nuclear export controls.

Questionable Legitimacy

Some states that are not members of the NSG regard this multilateral regime as constituting a cartel of supplier states that are trying to deny them their right to the peaceful uses of nuclear energy and recent proposals to restrict exports of E&R have only exacerbated this problem. The NSG has made efforts to combat this image by various outreach activities and transparency measures. Despite charges of discrimination and denial of rights, the international norms for nuclear export controls established by the NSG have become more widely accepted and a number of non-members, including Israel and India, have acknowledged that these rules can serve as a useful means of limiting the risks of civil nuclear trade and specifically the risks of enrichment and reprocessing.

SECTION V: OPTIONS

This section identifies and evaluates the advantages, disadvantages, and feasibility of options, to restrain transfers of E&R in ways that would be credible to governments and industry. These include steps to strengthen existing international mechanisms and norms and possible steps to create new ones. The options are organized around five broad possible ways to discourage the spread of E&R.

1. Persuading countries to agree formally to abstain from E&R capabilities;
2. Raising the barriers to legal transfers of E&R;
3. Raising the barriers to illicit or clandestine transfers of E&R;
4. Providing incentives to countries to forgo their own E&R capabilities; and
5. Limiting the risk of these technologies if they do spread to additional countries.

The options are not mutually exclusive, and some of them could be pursued in parallel or in combination.

Option 1: Convincing Countries That Do Not Presently Have Enrichment and Reprocessing Capabilities to Formally Forswear or Forgo Such Capabilities

As the Bush Administration's initial proposal to the NSG demonstrated, any attempt to establish a broad international norm banning the spread of E&R by states that do not presently have such capabilities is highly unlikely to succeed. However, the possibility of persuading individual states or states in particular regions of proliferation concern merits some further analysis.

1.1 Persuade Individual Countries or Countries in Regions of Proliferation Concern or Political Instability to Forswear or Forgo E&R.

Variations of this option have been tried in two areas—the Middle East and the Korean Peninsula—with varying degrees of success.

Middle East. In the last few years, a total of thirteen Middle Eastern countries have declared their intention to initiate civil nuclear power projects. The U.S. policy has been to support this interest but also to persuade states in the region to undertake a commitment to refrain from acquiring their own E&R capabilities. In its 2009 peaceful nuclear cooperation agreement with the UAE, the U.S. persuaded the UAE to assume a legal obligation not to possess enrichment and reprocessing technologies. The U.S. is now seeking to convince the Jordanians and others to accept the same restrictions.¹⁴ The U.S. also signed Memoranda of Understanding with Jordan, Saudi Arabia, and Bahrain in which those countries expressed their intention to rely on international markets rather than enrichment and reprocessing on their territories, but these do not constitute legally binding commitments.

14. Some Congressional staff members and nonproliferation experts in the United States have recently criticized reports that the United States is negotiating an agreement with Vietnam that would allow Hanoi to enrich U.S.-supplied uranium up to 20%, even though this is a standard provision that is found in all U.S. agreements, with the exception of the U.S.-UAE accord. These critics believe apparently believe that the U.S.-UAE agreement should be a model not merely for states in the Middle East but for other regions and states as well.

The Korean Peninsula. In 1992 North and South Korea agreed to a Joint Declaration on the Denuclearization of the Korean Peninsula, in which both parties agreed to forego possession of enrichment and reprocessing facilities. Since then North Korea has violated this understanding by resuming reprocessing and establishing an enrichment capability. South Korea is undertaking an effort to develop a pyroprocessing capability and has expressed interest in acquiring a domestic enrichment capability. Restoration of commitments made in the 1992 declaration could be part of an agreement on North Korean denuclearization.

Advantages

Acceptance of any of these models by additional countries in the Middle East or by North and South Korea would go a long way to reduce proliferation concerns in these volatile areas.

While getting other states to accept the kind of legal commitments in the U.S.-UAE agreement would be difficult, some other states in the Middle East may be willing to express their plans not to acquire E&R by less formal means, e.g. by statements of intent.

Resurrecting some form of the 1992 joint declaration by the two Koreas could help persuade North Korea to denuclearize. Agreements authorizing reprocessing or enrichment in South Korea would probably make it more difficult than it already is to gain a North Korean commitment to eliminate its reprocessing and enrichment capabilities.

Disadvantages

With a number of other potential suppliers available, states with nuclear power ambitions have no compelling economic incentive to conclude any kind of an understanding with the United States in which they would forswear E&R or even indicate their intention to abstain from such technologies. While some countries may value the conclusion of a peaceful nuclear cooperation agreement with the United States as a way to validate their nonproliferation credentials, U.S. attempts to insist on language in such agreements that would bar E&R may simply lead states to choose other suppliers.

Neither the NSG as a whole nor individual suppliers like France, Russia or South Korea are likely require their customers to forswear or forgo their rights to enrichment and reprocessing. As suppliers, these countries can offer E&R services commercially without transferring the technology to the recipient customer state and without requiring political commitments that would go against NPT article IV rights. Thus it is highly questionable whether the U.S.-UAE peaceful nuclear cooperation agreement will serve as a model for other agreements in the Middle East or elsewhere.

It remains to be seen whether it will be possible to resurrect the 1992 Joint Declaration for the two Koreas. The difficulty of convincing North Korea to eliminate its capabilities may be so great that it may not have a major influence on decisions about enrichment or reprocessing/pyroprocessing in South Korea.

Continuing to pursue this approach may exacerbate perceptions that the United States is seeking to take away the rights of some countries who are parties in good standing to the NPT.

Option 2: Undertake Steps to Make It Harder to Buy E&R Legally

2.1 Continue to Press for NSG Adoption of the So-Called Clean Text.

NSG member states favoring this approach could press South Africa to go along with the draft “clean text” as currently written. This option would probably require high-level intervention by U.S. as well as other NSG members.

Advantages

Since only one state is still opposing this option, its adoption by the NSG may be achievable, and there is time to pursue this objective since no NSG member is planning to transfer E&R in the foreseeable future to states that do not already possess such technologies.

NSG adoption of the new criteria for transfers of E&R could strengthen the existing guidelines by giving greater definition to the meaning of what constitutes restraint in export of such technologies.

Agreement not to transfer E&R to states in violation of their nonproliferation norms would constitute a strong political and normative barrier to providing sensitive assistance to such states. (The present guidelines [paragraph 16] call for suppliers only to consider suspension of trigger list items if a recipient is reported by the IAEA to be in breach of its safeguards obligations and to consult if one or more suppliers believes that there has been a violation of supplier/recipient understandings resulting from the guidelines.) Thus banning E&R transfers to non-compliant states would constitute a strengthening of the present guidelines.

By banning the transfer of E&R to non-NPT parties, the clean text would provide a clear preference to NPT parties over non-NPT parties and would thus help to mute the criticism that restrictions on E&R violate parties’ rights under Article IV of the Treaty. This assumes that the NSG adopts the clean text before the Indians are accepted into the NSG as the U.S. and others are promoting. Once an NSG member, New Delhi a non-NPT party, is likely to block consensus on banning transfers of E&R to non-NPT states

Disadvantages

If adopted by the NSG, the criteria set out in the clean text may be exploited by some suppliers who wish to transfer E&R technologies. The criteria would effectively allow transfers to any state that meets them—including most states pursuing nuclear energy—potentially giving a supplier who is intent on transferring sensitive nuclear technology a rationalization for such a transfer. Such a rationalization does not appear in the existing NSG “restraint” language.

Defining specific guidelines may lead to contentious debates about whether a specific criterion is met. For example, disagreements could easily arise over whether the recipient has a “credible and coherent rationale for pursuing enrichment or reprocessing capabilities in support of civil nuclear programs,” or whether the proposed transfer “would have a negative impact on the stability and security of the recipient state and general conditions of stability and security.” It also leaves open the question of whether and how enrichment technology can be effectively black-boxed. For example, even if access to the manufacturing and technology is

not transferred to a recipient, a country could take over a facility, reverse engineer a machine and the balance of plant, and use lessons learned from an advanced design and upgrade its centrifuge technology.

Banning the transfer of E&R to non-NPT parties may prove controversial since the United States and some other NSG members are promoting Indian membership in the NSG. If India becomes a member of the NSG, it could make agreement within NSG to refrain transferring E&R to non-NPT parties impossible.

The existing NSG guideline has been working well, and it could be argued that new criteria are neither necessary nor desirable since adopting them would only alienate the NAM and make international consensus on this issue more difficult. The NAM is likely to interpret the adoption of the clean text as further evidence that the NSG is nothing but a cartel bent on denying developing countries access to peaceful nuclear technology. NPT parties could argue that the clean text violates their rights under Article IV of the Treaty.

2.2 Limit the New Guidelines to the So-Called "Objective" Criteria of the Clean Text.

This option would not include the subjective criteria set out in the clean text such as: whether E&R transfers are intended for peaceful purposes; whether the recipient has a credible and coherent rationale for pursuing an enrichment or reprocessing capability in support of civil nuclear programs and whether the transfer would have a negative impact on the stability and security of the recipient state and general conditions of stability and security. This would also mean dropping the criteria for consultation prior to beginning transfers of E&R regarding the nonproliferation related terms and conditions applicable to the transfer as well as the so-called "black-box" approach to the transfer of existing enrichment technologies.

Advantages

NSG adoption of the objective criteria would constitute a strong political and normative barrier to exports of E&R to states that are not abiding by their nonproliferation obligations such as Iran and North Korea.

Since the objective criteria preclude the transfer of E&R to states in violation of their nonproliferation commitments, this approach could help to undercut the argument that any restrictions on E&R transfers are contrary to Article IV of the NPT.

Since it would rule out transfer of E&R technology to non-NPT states such as India, Israel and Pakistan, it could demonstrate that NSG is not giving preferential treatment to non-NPT parties.

Disadvantages

As above, this option could give a rationale for an E&R transfer that does not appear in the existing "restraint" language.

States desiring E&R could argue that, since they are not violating their nonproliferation norms, they should not be denied E&R even though a) they may be seeking such technology

to keep open the option to build nuclear weapons, or b) they may be located in regions of instability or proliferation concern.

Similarly, suppliers who want to transfer E&R could argue that, since a recipient is not in violation of its nonproliferation commitments, it meets the objective criteria.

This option would not include the black-box criterion, one to which the United States has ascribed particular importance. However, the disadvantage of excluding this condition is mitigated by the fact that transfers of E&R under black-box conditions have become the common practice.

2.3 Maintain Existing NSG Criteria For E&R Transfers.

The original guidelines published by the NSG in 1978 contained several guidelines for the transfer of E&R, including exercising restraint in transfers, encouraging multinational involvement, and requiring assurances by recipient not to produce highly enriched uranium.

Advantages

The existing guidelines have worked well, and NSG members have exercised considerable restraint in transferring E&R since the NSG's inception.

By putting the proposed new criteria aside, the NSG could focus on other important issues, such as adopting the Additional Protocol as a condition of export and updating its control lists to keep pace with developing technologies.

Living with the existing guidelines would mean dropping the compromise on the AP that the Brazilians and Argentines insisted upon and that would give NSG recognition that their regional safeguards arrangement is comparable to the AP, which it is not.

Dropping the effort to add new criteria for E&R transfers would help temper the acrimonious international debate that has taken place since President Bush's 2004 speech.

Disadvantages

The inability of the NSG to agree on new guidelines on the transfer of E&R would demonstrate a continued lack of consensus on this major issue, which could be exploited by some suppliers.

To the extent that the clean text clarifies what it means to exercise restraint in transferring E&R, keeping the existing guidelines would leave open varying interpretations of the E&R guideline and invite some NSG members to exploit the ambiguity of the existing language to justify transfers in the future.

2.4 Institutionalize Recent Understandings Among the G-8 to Exercise Restraint on E&R Transfers.

The members of the G-8 have agreed to apply the NSG "clean text" at least until they hold their next meeting in 2011. They also urged the NSG to come up with an agreement on E&R transfers. Thus the main enrichment and reprocessing technology holders are now applying the clean text

criteria for transfers of E&R. Under this option, the G-8 members would agree to apply the “clean text” indefinitely whether or not, or until, the NSG adopted this proposal.

Advantages

The G-8 agreement may be of more practical importance than the adoption of a new E&R guideline by the NSG, since the members of the G-8 are the world’s main E&R technology holders.

It should be less difficult, at least in theory, to reach consensus among G-8 members than in the NSG since the former is both smaller in number and less diverse in interest.

The G-8 has taken a much more politically positive approach to peaceful nuclear cooperation than the NSG has, e.g., by reaffirming the inalienable right of all parties to the NPT to the use of nuclear energy for peaceful purposes.

Disadvantages

The G-8 is a more select group of countries, and institutionalizing an agreement on E&R transfer would enjoy even less legitimacy than NSG adoption of new E&R guidelines.

Some key technology holders such as China, India, Argentina and Brazil are not members of the G-8 and would not be bound by any G-8 decision.

It is not known how long the G-8 will be willing to abide by the clean text without a NSG agreement on the issue.

Option 3: Make Illegal Transfers of E&R More Difficult

3.1 Strengthen Mechanisms for Controlling E&R Technology Transfers by NSG Members and Non-Members.

Given the success that certain countries have had in circumventing export controls, as well as the increasing export capabilities of non-NSG members, NSG member states could agree to take steps to strengthen export controls on E&R related exports. For example, they could agree to: share information on the techniques and methods that these countries employ to obtain exports illegally, including identification of companies or individuals that are part of smuggling networks; consult on ways to improve information sharing among each other and with states that are not members of the NSG; increase efforts to take a more active role in helping states build their legal and bureaucratic infrastructure to meet their obligations under UN Security Council resolution 1540; upgrade dual-use export controls on enrichment and reprocessing, particularly laser isotope separation (LIS); strengthen national laws and establish tougher penalties for participation in illegal E&R transfers; expand intelligence and law enforcement cooperation targeted on black-market nuclear technology networks; provide more information to the IAEA; and enhance cooperation with private industry. Finally NSG members could help non-NSG members in implementing UN Security Council resolutions directed at the international trade of such countries as Iran and North Korea.

Advantages

Focusing on illicit transfers would more directly address the actual problem of clandestine E&R transfers than does strengthening the NSG guidelines.

Disadvantages

This approach may not be able to overcome strong reluctance of the NSG to share information about such matters as licenses they have approved or denied for the sale of controversial items to nonmember states, specific exporters during ongoing investigations prior to judicial proceedings and procurement activities by countries of proliferation concern.

Option 4: Positive Incentives to Countries to Forego Their Own Enrichment and Reprocessing Capabilities

4.1 Fuel Assurances.

A number of proposals have emerged in recent years to provide enhanced nuclear fuel guarantees as an incentive for states to rely on the international market and to forgo the development of expensive national fuel cycle facilities. These have included:

- An IAEA mechanism for reliable access to nuclear fuel (RANF).
- A German proposal for the establishment of an enrichment facility on international territory administered by the IAEA;
- A proposal by the United Kingdom for the establishment of a series enrichment bonds that would involve agreement among supplier states, recipient states and the IAEA to cope with supplier disruptions not related to nonproliferation considerations;
- A proposal by Japan that called upon countries that can supply, refine, convert, enrich and store uranium ore to register with the IAEA.

Some fuel assurance arrangements have already been established, while others are in the process of being put into effect.

- The Russians established an international fuel cycle center at Angarsk;
- The U.S. and Russia each established an LEU reserves by. Both the U.S. and Russia would supply uranium to countries that suffered a disruption in supply not related to their nonproliferation obligations. The Russian reserve is specifically set aside for use by the IAEA to meet the emergency needs of member states that are in compliance with their nonproliferation objectives.
- The IAEA Board of Governors has now approved the establishment of an IAEA fuel bank, which presumably will be located outside of the current major supplier states.
- The IAEA Board of Governors has also approved a British proposal for enrichment bonds that envisions an agreement among supplier state governments, the recipient state and the IAEA, in which the supplier government (s) would guarantee subject to compliance with international law and the nonproliferation commitments, national enrichment providers will not be prevented from supplying the recipient state with enrichment services in the event that the guarantee is invoked.

Since the commercial nuclear fuel market has worked quite effectively, these reserves can be expected to have modest but positive benefits in increasing states' confidence that they can safely rely on fuel supply from international sources rather than investing in enrichment facilities of their own.

It bears emphasis that potential recipients applying for LEU from the Russian-IAEA reserve or the IAEA fuel bank or triggering the British enrichment bond scheme will not be required to diminish their rights to establish or expand their own nuclear fuel production capabilities.

Advantages

An international fuel bank has certain advantages over the national reserves established by the U.S. and Russia. It will offer an assured international supply of nuclear fuel from a "neutral" source on a non-discriminatory, non-political basis to states that are meeting their non-proliferation obligations. Small states, in particular, may have more confidence in their ability to obtain nuclear fuel supplies through an international organization such as the IAEA than by purchasing low enriched uranium bilaterally from one of the large enrichment suppliers who may be influenced by extraneous political or commercial considerations.

The IAEA fuel bank and the British bond scheme plus the Russian and U.S. reserves could be relevant if they can be seen as meeting short-term supply interruptions in small countries that may not have a great deal of experience in operating in the international nuclear market.

Disadvantages

Improved fuel assurances may have limited value in discouraging states from acquiring E&R. States that place a premium on enhancing energy independence or selling enrichment services on the international market are not likely to forgo these capabilities, even if they are offered attractive nuclear supply assurances. States that want to acquire E&R because of the military nuclear option it provides seem even less likely to change course in response to more robust fuel assurances (though the availability of such assurances may make it easier to raise questions about why such a state is pursuing these capabilities).

4.2 Multinational Participation to Enhance Fuel Assurances.

This option would entail offering enhanced fuel assurances by inviting countries to participate in multinational enrichment and/or reprocessing facilities. NSG members who are E&R technology holders could offer countries that do not possess enrichment facilities and that are in good non-proliferation standing the opportunity to invest in the enrichment plants of NSG member states. In the case of enrichment, such participation could include guaranteed supplies of nuclear fuel, investment and participation in management and policy decisions, but, in most concepts, would *not include access to enrichment technology*. Eurodif and the International Uranium Enrichment Center at the Angarsk Electrolysis Chemical Complex in Siberia are examples of this option. In the case of reprocessing, multinational arrangements would have to include appropriate controls on the recovered plutonium.

Advantages

Some countries, particularly those with small civil nuclear programs, could conclude that participation in large multinational plants can offer a more cost-effective way of securing reliable supplies of fuels or services than trying to meet their nuclear requirements using national alternatives.

In the case of enrichment, such a model would also help prevent the spread of isotopic separation facilities by restricting access to classified enrichment technology.

Multinational E&R facilities have been shown to be not only feasible but perhaps desirable from a commercial perspective. A number of multinational ventures in sensitive nuclear fuel cycle activities have already been established, e.g., EUROCHEMIC, a pilot reprocessing plant was established under the auspices of the Organization for European Economic Cooperation (OEEC, a forerunner of the European Union) as a training center for reprocessing technologies and for a number of its supporters hopefully the basis of a European-wide multinational reprocessing center; URENCO, EURODIF, and the Russian enrichment facility at Angarsk were established as uranium enrichment consortia; the GE-Silex facility in the United States is also a multinational venture, as are the new URENCO USA facility and the planned Areva enrichment facility in the United States. USEC (formerly the United States Enrichment Corporation) has recently accepted investment from a Japanese supplier for its new enrichment plant. AREVA's Georges Besse II enrichment plant has accepted investment from Japanese utilities.

If enrichment technology holders, most of whom are NSG members, were to invite multinational participation in their own enrichment facilities, it would serve to promote multinational as opposed to national plants as the global norm.

Non-nuclear-weapon states and members of the NAM might view multinational facilities as less discriminatory than a regime that would allow some states to continue their national programs while strongly discouraging other states from acquiring such technologies.

Multinational E&R facilities might provide the international community with additional assurances, through greater transparency, that such facilities will not be misused for military purposes.

Disadvantages

If operators of existing technology holders resist multinationalizing their plants in some appropriate way, some non-nuclear weapon states may see this as a form of discrimination. However, the U.S. acceptance of black-boxing on its soil may mitigate this sort of criticism.

Establishing a multinational venture would most likely require the development of political, operational, economic and managerial organizations of considerable complexity. Multinational arrangements may be vulnerable to political differences among the participants¹⁵ that could

15. The difficulties between Iran and Eurodif illustrate that a multinational facility can be affected by political disputes among the parties. In 1974 Iran loaned Eurodif \$1 billion to establish a uranium enrichment plant in Tricastin, France. Iran was expected to purchase 10% of the enriched uranium fuel produced by Eurodif. The Shah also entered into negotiations to buy a portion of a second enrichment plant planned by a second French consortium (COREDIF) that was subsequently cancelled. In June 1979 the revolutionary government that had overthrown the

have negative effects on their normal operations. However, the separation of non-operational from operational activities and political from commercial-managerial considerations, as is the case with URENCO, would go a long way to reduce this risk.

Different approaches to multinational ownership and control could have quite different proliferation implications, and these would have to be carefully considered. In particular, international staffing of enrichment facilities might have advantages in some cases, but could also lead to leakage of sensitive technology¹⁶, and arrangements to prevent such problems would have to be carefully thought through. Multinational enterprises such as the one at Angarsk, where the enrichment plant itself remains wholly owned and operated by the host state, might not do much to mitigate proliferation concerns if the multinational plants were established in new states with questionable nonproliferation credentials.

States like Iran and North Korea are unlikely to forgo their own enrichment and reprocessing programs in exchange for the opportunity to participate in any multinational E&R venture (though Iran has hinted that it might be willing to accept international participation in its own program).

Although not openly rejecting them, the U.S. does not appear to be particularly supportive of multinational approaches to enrichment plants, at least in the near-term.

4.3 “Cradle-to-Grave” Incentives.

The U.S. has been exploring the possibilities of developing offers by one or more suppliers to lease or sell power reactor fuel to consumer states, with the understanding that the resultant spent fuel would be returned to one of the supplier countries or to suitable alternative locations, such as a regional or international used fuel storage facility or waste repository, (if a host state can be found), where it would be treated, recycled or where wastes could be ultimately disposed of.

4.3.1 Offering a Broad-based Cradle-to-Grave Fuel Cycle Service.

This option would involve a major diplomatic initiative to explore the possibility that one or more supplier states could offer cradle-to-grave services to all states without E&R plants as an incentive for states to forgo the development of such capabilities.

Advantages

If one or more suppliers could offer a “cradle-to-grave” fuel supply program, it could prove to be far more effective than some other techniques in discouraging the spread of reprocessing facilities. Because the commercial market already provides strong assurance of fresh fuel supply, while management of spent fuel is unresolved, such a service offer could create stronger incentives for countries to rely on international fuel supply than steps such as fuel banks would.

Shah indicated that it wished to withdraw from the Eurodif arrangement. At the end of 1979 a French court froze Iran's stake in Eurodif pending negotiating withdrawal with the European partners. In early 1980s the Iranian Atomic Energy Authority reportedly denied Iran's intent to withdraw. In 1991, the International Commerce Commission ruled that France had to repay the loan and that Iran would keep a small share of Eurodif, but France said it would not transfer the enriched uranium to Iran.

16. Some believe that the multinational nature of URENCO facilitated the leakage of classified enrichment technology to Pakistan.

Russia has already implemented such a program on a limited scale. Moscow has concluded an agreement to provide fresh nuclear fuel for the Bushehr nuclear power plant in Iran and to take back the used nuclear fuel to Russia. The Russians have also taken back some spent power reactor fuel from East European countries and have indicated that they might be willing to consider taking back spent fuel of Russian-origin in the future—they have recently offered such deals to Vietnam and Turkey—but do not seem ready to accept spent fuel produced from fuel from non-Russian suppliers.

If Russia were to offer a broad-based a cradle-to-grave program, it may put pressure on its competitors in the reactor and enrichment markets to try to follow suit.

If a country agreed to accept spent fuel from other countries on a commercial basis, the supplier of the fresh fuel and the country to which the spent fuel was sent would not have to be the same for a cradle-to-grave service to work.

Disadvantages

The political obstacles to offering broad-based cradle-to-grave services will be formidable. With the possible exception of Russia, no major supplier country is currently in a position to provide power reactor fuel to other countries with a firm commitment to take back the used nuclear fuel. France and the UK accept foreign spent fuel for reprocessing but require the return of waste and recovered material to the sending state—although if a market for MOX emerges, they could convert such material to MOX and sell it to utilities in other European states. No other countries have yet been willing to accept other states' spent nuclear fuel.

4.3.2 Offering Cradle-to-Grave Services for Limited Quantities of Spent Fuel from Small Countries.

The MIT report on the nuclear fuel cycle advocated that the U.S. and other nuclear supplier countries should actively pursue fuel leasing options for countries with small nuclear programs, providing financial incentives for forgoing enrichment, technology cooperation for advanced reactors, spent fuel take back within the supplier's domestic framework for managing spent fuel, and the option for a fixed term renewable commitment to fuel leasing (perhaps ten years).

Advantages

This approach could prove to be a powerful incentive for countries with small programs to abstain from developing their own enrichment and reprocessing capabilities.

While most suppliers would find it politically difficult or impossible to offer a broad-based cradle-to-grave program, it may prove possible to take back limited quantities of spent fuel from countries with small nuclear programs.

Disadvantages

Even a limited offer could present enormous domestic difficulties for suppliers until they can resolve their own national waste management problems.

Although acceptance would be voluntary, NAM members could individually or collectively reject such an offer as an effort to deprive them of the peaceful benefits of nuclear energy.

4.3.3 Offering Cradle-to-Grave Services to Countries in Regions of Instability or Proliferation Concern.

A variation of this option is for suppliers to offer cradle-to-grave fuel cycle options to states in an area of proliferation concern such as the Middle East. An offer by supplier to states in the Middle East could have important nonproliferation implications for the region in the future. As noted, Russia has already made such an arrangement with Iran. On a more limited scale, the United States incorporated unprecedented non-proliferation controls in its 1981 peaceful nuclear cooperation agreement with Egypt which bar reprocessing in that country and require that the disposition of special nuclear material be in a third country agreed to by the parties, -or in the United States if it is prepared to accept such special nuclear material. Thus although suppliers are not now in a position to offer broad-based cradle-to-grave policies to all their customers, it may be possible for some to consider more limited offers such as the arrangements for the used fuel from the Bushehr reactor that Russia has concluded with Iran and the special controls the U.S has secured in the U.S.-Egyptian peaceful nuclear cooperation.

Advantages

As in the previous option these services would provide the added advantage of providing a stronger national security justification for taking back a limited amount of spent fuel from a dangerous area.

Disadvantages

This arrangement would still likely face daunting domestic political opposition in supplier countries.

Although acceptance of the offer would be voluntary, NAM members could reject such a proposal as an effort to deprive them of the peaceful benefits of nuclear energy.

Option 5: Limiting the Risks of E&R if these Sensitive Nuclear Technologies Spread

Over the next several decades, it seems unlikely that efforts to stem the spread of E&R technologies will be 100 percent successful. If additional countries acquire such technologies, the question is then: how to limit the risks attendant on such spread?

Continued development and deployment of improved safeguards techniques and cooperation on physical protection should be a straightforward part of any strategy to limit the risks of the spread of sensitive nuclear fuel cycle capabilities. So-called proliferation-resistant fuel cycles are in the early stages of study and will require further research, development and demonstration. Moreover, by themselves, such technologies will probably not serve as effective barriers to proliferation unless accompanied by strengthened international safeguards, export controls, institutional checks, diplomacy and other non-technical measures. Even if one or more of these technologies prove feasible and effective, their deployment will most likely be a long-term proposition.

Already, the notion of limiting the risks if and when E&R technologies do spread is embedded in the criteria-based approach being discussed in the NSG. That approach is based on the notion

that transfers of E&R technology would pose less proliferation risk, and would therefore be authorized, if they were (a) made to states that met certain criteria, and (b) managed in particular ways (e.g., in a “black box” approach). The advantages and disadvantages of limiting transfers based on the “clean text” are discussed above. Another approach to limiting the risks that arise when E&R technologies do spread is discussed below.

5.1. Elevate Multinational Ownership, Control, or Staffing of, E&R Facilities to an International Norm.

The existing NSG guidelines already contain a provision encouraging multinational participation in E&R plants:

If enrichment or reprocessing facilities, equipment or technology are to be transferred, suppliers should encourage recipients to accept, as an alternative to national plants, supplier involvement and/or other appropriate multinational participation in resulting facilities. Suppliers should also promote international (including IAEA) activities concerned with multinational regional fuel cycle centres

The NSG could strengthen this provision by stipulating that suppliers should “require” rather than encourage “supplier involvement” or “appropriate multinational participation” as an alternative to national enrichment plants. However, there is no single multinational formula that would be satisfactory for all technologies, all partners or all locations. Whether a given model would be feasible and effective depends on a number of factors including who is seeking E&R technologies and for what purpose; their political, economic, commercial, financial, organizational benefits and costs; their locations; the terms and conditions for having access to the technology.

There are many different types of multinational “involvement” which would have different implications. If a state in a region such as the Middle East was building an enrichment plant which was “multinational” only in the sense that a couple of other countries had small minority shares in ownership, with no real role in controlling or operating the facility (as is the case with the Russian enrichment plant at Angarsk), this might not reduce proliferation concerns much compared to a purely national facility. On the other hand, a circumstance in which a facility was owned and all decisions controlled by a multinational consortium in which no one state had a majority might significantly increase the political barriers to using that facility for weapons purposes. Such a facility might also be on land designated as extraterritorial, that is, beyond the legal authority of the host state, as is the case with United Nations offices in New York and several other countries, the CERN physics laboratory, or the headquarters of the European Central Bank. The German Government has proposed the concept of an international enrichment facility involving extraterritoriality. (There would clearly have to be provisions for the host state to be able to impose appropriate regulation to assure safety, however.) A facility that had 24-hour international staffing as well would offer a significant additional degree of transparency beyond what international inspection can provide, since the actual operators of a plant inevitably understand what is happening there better than international inspectors do. At the same time, however, it would be important to understand the implications of the particular staffing approach for potential leakage of sensitive technology.

Multinational approaches to enrichment and reprocessing technologies entail significantly different nonproliferation risks. Key aspects of most enrichment technologies remain classified, and

denying or limiting access to technology by participants or customers must be an essential component of any multinational or international institutional enrichment arrangement. By contrast, the basic technology for reprocessing was made public decades ago and is well known and widespread. Thus restricting technology transfer in the case of multinational or international reprocessing is not as critical for reprocessing as it is for enrichment. Nevertheless, operational experience in a multinational commercial reprocessing or pyroprocessing facility could enable states to obtain the necessary expertise and know-how to build and run a large-scale plant. A multinational or international reprocessing plant could limit this risk by requiring participating states to agree to forswear the replication of any reprocessing facility in their own country or to agree that a replicated facility would have to be placed under comparable multinational auspices or control and would be considered only when there was a substantial and clear economic justification for building such a facility. However, such requirements could reduce the incentives for states to invest in or otherwise participate in the multinational facility.

Advantages

If properly designed and implemented, multinational involvement or control of an E&R plant could provide significant barriers to misuse of the facility. For example, Geoffrey Forden and John Thompson of MIT have proposed a detailed arrangement for a multilateral enrichment facility in Iran that includes transparency measures and self-destruct and disabling mechanisms that the authors argue would protect both against diversion of material and, to some degree, against the establishment of a clandestine facility.¹⁷

A multinational staff participating in the operational aspects of the plant could add a greater degree of transparency to the plant and would provide greater degree of scrutiny of plant operations and complimentary deterrence to diversion or misuse of the facility than if the facility were operated by the host-country nationals only. There would have to be strict arrangements to prevent the dissemination of sensitive nuclear technology.

Disadvantages

If existing enrichment and reprocessing facilities in the supplier countries were not made multinational, this approach might be seen by the NAM and by other countries as discriminatory, imposing additional burdens on their exercise of what they see as their right to make their own fuel cycle choices.

States and firms already operating nationally controlled enrichment and reprocessing facilities may not wish to involve multinational partners in these facilities.

Some approaches could have the counterproductive effect of stimulating unnecessary early deployment of high-risk technology, such as reprocessing, or the dispersal of sensitive materials like plutonium in politically unstable areas or in countries where such plants have little or no economic or programmatic justification.

If not properly designed and operated, a multinational enterprise could result in spreading rather than containing enrichment technology. In particular multinational participation or

¹⁷ Geoffrey Forden and John Thompson, "Iran as a Pioneer Case for Multinational Nuclear Arrangements," Science, Technology and Global Security Workshop, MIT, May24, 2007.

involvement must be constructed in ways that limit the dissemination of classified information to the technology holder and limit the distribution of know-how to other participants, e.g. as in the case of EURODIF and Angarsk. With respect to reprocessing, a multinational venture should be designed to ensure that the plutonium distribution policies adopted are compatible with nonproliferation goals.

Industry would be reluctant to share technology within a broad multinational context and the implementation of a multinational arrangement would be problematic from a commercial point of view.

It is open to question whether the availability of multinational alternatives to national development would persuade a state to abandon existing or planned national enrichment and/or reprocessing capacity to abandon that in favor of a multinational option. It is not likely to dissuade countries like Iran or North Korea from their E&R ambitions.

Multinational involvement might reduce, but would not eliminate, the risk of host country takeover.

Industry might be reluctant to share to endorse the multinational approach.

SECTION VI: CONCLUSIONS AND RECOMMENDATIONS

The NSG has long had in effect a guideline that called upon supplier states to exercise restraint in the transfer of such technologies. With the exception of some reported enrichment assistance by Russian entities to Iran, no members of the NSG have transferred enrichment or reprocessing technology since the 1970s to states that did not already possess such technology. So President Bush's proposal of 2004 really meant formalizing a moratorium that NSG members had quietly adhered to in practice for some time. However, by trying to make this practice into new formal and more specific NSG guideline, the U.S. initiative exposed differences among NSG members on what it means to "exercise restraint" in the transfer of such technologies and prompted a wider and a discordant debate across the international community on this issue.

Moreover, only a handful of states possess enrichment and reprocessing facilities at the present time, and very few countries that do not already possess them have declared plans or intentions to acquire such capabilities for their civil nuclear programs in the foreseeable future. Therefore, initiatives to discourage the spread of enrichment and reprocessing facilities may have a limited, albeit an important, target audience.

Any attempt to move this issue forward will confront several conflicting interests and political positions held by various states.

Since few states have a firm stake in acquiring E&R facilities, it may prove an opportune time to win broad agreement on strengthened international norms to discourage the spread of enrichment and reprocessing plants. On the other hand, several nations have expressed an interest in acquiring a commercial enrichment capability at some time in the future, but do not appear to have developed specific plans to do so at this time. Many of these countries have made clear that they do not intend to foreclose the opportunity to acquire such technology or to forego their rights to do so.

It will be challenging, and indeed may ultimately prove impossible, to reconcile the idea of restricting enrichment and reprocessing technologies with the views of many non-nuclear-weapon states and developing countries on what they regard as their inalienable rights to peaceful nuclear technology, including E&R. At the heart of these differences is the belief by many that the U.S. proposals and the NSG efforts to ban or strengthen restrictions on the transfer of enrichment and reprocessing technologies and to provide enhanced fuel assurances only to countries that fore-swear such technologies are inconsistent with their sovereign rights as states and with their rights under Article IV of the NPT to pursue their own peaceful nuclear program, including enrichment technology. Moreover, they view such initiatives as fundamentally discriminatory in nature. Developing countries in particular hold to the view that they have an inalienable right to make energy choices and view efforts to restrict E&R as a form of nuclear colonialism. Moreover, NPT parties may find it particularly exasperating that U.S. efforts appear to acquiesce in the reprocessing and enrichment programs of non-NPT parties such as India, Israel and Pakistan simply because they already possess such facilities while denying such capabilities to NPT parties that are in full compliance with their treaty obligations.

Several parties to the Treaty take the position that Article IV implicitly entitles any Party in good-standing to acquire its own independent fuel cycle, including enrichment and reprocessing, so long as it fully abides by the Treaty's provisions. The incorporation of Article IV into the NPT was a basic bargain that proved essential to the success of the negotiations and the entry into force

of the Treaty. The philosophy underlying this provision was that, if non-nuclear weapon-state parties to the Treaty agreed to forswear the manufacture acquisition of nuclear weapons and accept IAEA safeguards on all their peaceful nuclear activities, they should be assured the right to obtain the full benefits of the peaceful uses of nuclear energy. In addition, the bargain meant that most advanced nuclear powers should be willing to cooperate with the less advanced, non-nuclear-weapon states part to the Treaty to help them take advantage of the peaceful uses of nuclear energy.

However, even if these interpretations of the NPT were broadly accepted, it does not mean that the Treaty obliges a supplier state to provide a specific nuclear technology such as enrichment or reprocessing to a non-nuclear-weapon state party to the Treaty, or to engage in civil nuclear cooperation with a particular party. Moreover, Article IV specifies that a party's rights to peaceful nuclear programs must be in accordance with Articles I and II of the Treaty. It has already proved to be politically untenable to draw sharp distinctions, as the President Bush's proposal did, between states that already possess enrichment and reprocessing plants and those that do not presently have such capabilities.

Proposals to limit the spread of enrichment and reprocessing technology are inherently discriminatory. However, in considering the transfer of such sensitive technologies, it is entirely appropriate to distinguish among qualitatively different situations in various countries and to take into account a recipient country's nonproliferation commitments, intentions, civil power needs and the status of its energy program. Moreover, nondiscrimination is not always a virtue. Under President Carter the United States adopted a policy that all countries, including the U.S. and other advanced industrial states that were allies of the U.S. and that had already made substantial investments in fuel cycle facilities, should postpone or abandon their fuel cycle plans. This approach not only produced a great deal of acrimony between allies but failed to stop reprocessing programs in these states. The U.S. eventually adopted policies that accepted fuel cycle programs in countries that already possess well established enrichment and reprocessing programs and strong nonproliferation credentials and focused on preventing the spread of E&R capabilities to additional countries especially those that present a genuine proliferation risk or are located in regions of instability.

The charges by developing countries that restrictions on E&R transfer are discriminatory are more political and symbolic than practical, since only a small number of countries have the resources, the infrastructure or nuclear power programs that would justify the acquisition of enrichment or reprocessing capabilities. The relatively low price of uranium and an ample supply of enrichment capability mean that the vast majority of countries will not be adversely affected by the absence of an indigenous enrichment or reprocessing capability. There is therefore no need for states to acquire reprocessing and enrichment at least until there is some fuel cycle and economic justification for the establishment of such facilities in these countries, or for as long as reliable external sources of supply are available elsewhere.

Given the above considerations, the following recommendations are offered.

Moderate the rhetoric on limiting E&R transfers in large international fora and stress the Article IV rights of NPT parties and assistance to developing countries. Given the sharp divisions in the global community on this issue, a broad international consensus enshrined in a document produced in international fora such as an NPT Review Conference, the IAEA or the UN Security Council or General Assembly that would be universally credible to NPT parties, national

parliaments and private industry and would resolve the multiple divisions among all NPT parties is most likely not an achievable goal. The most pragmatic strategy in such international fora would be to continue to tone down the rhetoric, emphasize the rights of NPT parties to the peaceful uses of nuclear energy as long as they are in compliance with their nonproliferation objectives and increase assistance to developing countries in building the infrastructure for a peaceful nuclear program. In other words, it makes more sense to offer attractive incentives and opportunities as an alternative to national enrichment and reprocessing than to propose schemes or proposals that openly seek to deny what countries consider their sovereign rights.

Concentrate on reaching agreement on the clean text on E&R transfers in the NSG. Efforts to strengthen controls on transfers of E&R are more likely to succeed in a smaller group such as the NSG or the G-8. Even here as the debates that have taken place over the last six years have shown, developing such a consensus has not proved easy and thus far not achievable in the NSG. The NSG has come very close to reaching agreement on the clean text. Abandoning the effort at this point would represent a major failure. Since there are no transfers of E&R contemplated in the foreseeable future, there is still ample time to try to obtain consensus on the clean text. With sufficient diplomatic effort, this could very well be achievable.

In the meantime, the G-8 should continue to adopt the clean text either on an annual or more permanent basis.

If agreement on the current clean text proves impossible, adopt the objective criteria in the clean text. If agreement on all aspects of the clean text proves impossible, a compromise may be possible on the adoption of the so-called “objective” criteria, i.e., those that would rule out E&R transfers to states that are not party to the NPT or that are not adhering to their nonproliferation commitments. This option would retain the existing NSG guidelines on E&R transfers, including the requirements to exercise restraint and encourage multinational or supplier involvement in transferred E&R facilities.

In any event, the precise language the NSG adopts on the transfer of E&R is less important than the continued adherence by member states to their long-standing practice of exercising restraint in the export of these technologies.

Adopt new language in the NSG guidelines that would affirm Article IV rights and register commitments to promote international cooperation with states as long as they are in conformity with the obligations of NPT. If the NSG adopts the clean text or only the objective criteria, the group should take steps to mute criticisms of discrimination and denial of NPT rights and to help refute charges that the NSG is a cartel of nuclear haves seeking to deprive have-nots of the full benefits of peaceful nuclear technology. It is important to note that the NSG is not the Nuclear Export Control Group but the Nuclear Suppliers Group. The NSG should, therefore, adopt, along with strengthened controls on E&R, new formulations in its published guidelines that would affirm the inalienable right of all NPT Parties to the peaceful uses of nuclear energy and register the commitment of NSG members to the exchange, of equipment, materials and scientific and technological information for the peaceful uses of nuclear energy, in particular for developing countries, as long as there are in conformity with the obligations of NPT. Similar declarations are found in statements of the G-8, the UNSC resolution (1887) (2009) on nonproliferation and disarmament and documents of the NPT Review Conference. There is no reason that the NSG could not incorporate similar ideas in

its guidelines. Offering to do so may also help to reassure suspicious members of the NSG and to break the present impasse on the clean text. It may also help to mitigate suspicions among non-NSG members that the NSG is a cartel that is aimed at depriving non-members access to peaceful nuclear technology.

Strengthen NSG efforts on effective implementation of the existing guidelines. These guidelines have worked well to date, and the real problem has been the work of clandestine supply networks by rogue suppliers and countries seeking nuclear weapons. The NSG should commit to greater cooperation in sharing information on the techniques and methods that rogue supplier states and nuclear weapons aspirants employ to obtain exports illegally. This should include a greater willingness to share intelligence information with targeted exporting states both NSG members and non-NSG members. The NSG could also agree to upgrade its nuclear trigger list items as well dual-use export controls on enrichment and reprocessing particularly LIS (The NSG has already agreed to set up working groups to upgrade its nuclear and dual-use items). NSG members could also agree to enhance cooperation with private industry and engage more strongly in discussing and reporting on national outreach programs. Even if the NSG were to adopt strengthened guidelines, members should agree to put in place measures to ensure greater cooperation on effective implementation of the guidelines.

Promote fuel assurances. A strategy of offering improved fuel assurances may have limited benefits in discouraging the spread of enrichment and reprocessing and is likely appeal only to small states that may be concerned about security of supply and do not know their way around the international nuclear fuel market. In any event, the U.S. and Russian LEU stockpiles plus the IAEA fuel bank and the UK enrichment bond scheme ought to constitute sufficient fuel supply backup mechanisms without disrupting the global market.

Give serious consideration to placing enrichment and reprocessing facilities under some form of multinational auspices or control. Such a strategy represents special opportunities and challenges. Pressing states to place reprocessing facilities under some form of multinational auspices or control presents several problems. First, it provides some states with a justification for moving to reprocessing and recycling prematurely when such a step is not justified on economic or programmatic grounds. Second, it may be difficult to persuade at least some reprocessing technology holders to support this idea. The Russians have given some hints that they might consider some form of multinational involvement in a reprocessing facility at Angarsk, but it may be difficult to persuade other countries such as Japan to offer multinational participation in their Rokkasho plant¹⁸. Third, reprocessing states are likely to insist upon the return of separated high-level wastes to the originating state as do the French and the British. Fourth, since states that send their spent fuel to a multinational reprocessing plant are likely to insist on retaining title to the plutonium product, the return of such plutonium to the participating state presents major nonproliferation risks. For all of the above reasons, pressing for a multinational approach to reprocessing plants appears premature at this time.

However, there might be some benefit in states who are holders of enrichment technology, either as part of a new set of NSG criteria or as a separate initiative, to offer financial participation, input into the policy making and management, and improved fuel guarantees (but not access to sensitive technology) to small states, developing countries, or states with uranium reserves as an incentive not to acquire their own national enrichment capabilities. Such an offer would help to

18. The Japanese may consider multinational participation in a second reprocessing plant.

promote an international norm that enrichment facilities should be multinational in nature. However, this would probably require that the United States, which now seems cautious about promoting multi-nationalism as a means of constraining the spread of E&R, to adopt a new more active role in promoting this concept. In any event, even if technology holders do not make an effort to make the multinational model a global norm, multinational enrichment ventures of one kind or another seem to have emerged as common practice among technology holders with AREVA, URENCO, Angarsk, Silex and now USEC all involving some form of multinational participation. At a minimum this trend should be encouraged.

Recognize the limited application of the U.S.-UAE model of discouraging the spread of E&R.

The UAE model that the United States has been promoting for the Middle East will face considerable obstacles in winning acceptance by other states both in the region and elsewhere. Moreover, other suppliers are highly unlikely to follow this model. Thus the utility of this approach to preventing the spread of E&R may be limited to a very few countries at most, and the prospects of it serving as a more general model are dim.

Seriously explore feasibility of cradle-to-grave options particularly for countries with small nuclear programs. Suppliers will generally face formidable public acceptance obstacles in trying to offer cradle-to-grave fuel cycle services, especially on a broad basis. However, suppliers may find it possible to overcome political opposition if they limit their offers to assume responsibility for managing other countries' spent fuel to those nations that have small nuclear programs and/or are in regions of political instability or proliferation concern.

Give priority to development and deployment of improved safeguards techniques, including universal adoption of the Additional Protocol as well physical protection for enrichment and reprocessing plants.

Continue further research, development and demonstration of more proliferation-resistant fuel cycle technologies. However these efforts must be accompanied by strengthened international safeguards, export controls, institutional checks, and other non-technical measures. Moreover, they should not be used to justify the transfer of sensitive nuclear technology to areas or countries of proliferation concern.

Apply the maximum diplomatic pressure to states that seek to transfer sensitive nuclear technology to countries that are in violation of their nonproliferation commitments, are located in unstable regions or present unacceptable proliferation risks. It bears reemphasis that the NSG can provide norms and standards but cannot guarantee that a member will not supply or will not tolerate the supply by its private entities of E&R technology or E&R related dual-use items to countries of proliferation concern or in cases where there is no economic or programmatic justification. Moreover, diplomatic interventions and interdictions have been the most effective means of stopping the spread of E&R, e.g. the United States with proposed German and French transfers of reprocessing to South Korea, Taiwan and Pakistan in the 1970s, the U.S. diplomatic initiatives with proposed Russian transfers of enrichment technology to Iran, and the interdiction of Pakistani transfers of sensitive nuclear technology to Libya. NSG members should seek to dissuade suppliers who intend to export sensitive nuclear technologies when such a transfer presents unacceptable proliferation risks.

APPENDIX 1

Guidelines For Nuclear Transfers

1. The following fundamental principles for safeguards and export controls should apply to nuclear transfers for peaceful purposes to any non-nuclear-weapon State and, in the case of controls on retransfer, to transfers to any State. In this connection, suppliers have defined an export trigger list.

Prohibition on nuclear explosives

2. Suppliers should authorize transfer of items or related technology identified in the trigger list only upon formal governmental assurances from recipients explicitly excluding uses which would result in any nuclear explosive device.

Physical protection

3. (a) All nuclear materials and facilities identified by the agreed trigger list should be placed under effective physical protection to prevent unauthorized use and handling. The levels of physical protection to be ensured in relation to the type of materials, equipment and facilities, have been agreed by the suppliers, taking account of international recommendations.
(b) The implementation of measures of physical protection in the recipient country is the responsibility of the Government of that country. However, in order to implement the terms agreed upon amongst suppliers, the levels of physical protection on which these measures have to be based should be the subject of an agreement between supplier and recipient.
(c) In each case special arrangements should be made for a clear definition of responsibilities for the transport of trigger list items.

Safeguards

4. (a) Suppliers should transfer trigger list items or related technology to a non-nuclear weapon State only when the receiving State has brought into force an agreement with the IAEA requiring the application of safeguards on all source and special fissionable material in its current and future peaceful activities. Suppliers should authorize such transfers only upon formal governmental assurances from the recipient that:
 - if the above-mentioned agreement should be terminated the recipient will bring into force an agreement with the IAEA based on existing IAEA model safeguards agreements requiring the application of safeguards on all trigger list items or related technology transferred by the supplier or processed, or produced or used in connection with such transfers; and
 - if the IAEA decides that the application of IAEA safeguards is no longer possible, the supplier and recipient should elaborate appropriate verification measures. If the recipient does not accept these measures, it should allow at the request of the supplier the restitution of transferred and derived trigger list items.

- (b) Transfers covered by paragraph 4 (a) to a non-nuclear-weapon State without such a safeguards agreement should be authorized only in exceptional cases when they are deemed essential for the safe operation of existing facilities and if safeguards are applied to those facilities. Suppliers should inform and, if appropriate, consult in the event that they intend to authorize or to deny such transfers.
 - (c) The policy referred to in paragraph 4 (a) and 4 (b) does not apply to agreements or contracts drawn up on or prior to April 3, 1992. In case of countries that have adhered or will adhere to INFCIRC/254/Rev. 1/Part 1 later than April 3, 1992, the policy only applies to agreements (to be) drawn up after their date of adherence.
 - (d) Under agreements to which the policy referred to in paragraph 4 (a) does not apply (see paragraphs 4 (b) and (c)) suppliers should transfer trigger list items or related technology only when covered by IAEA safeguards with duration and coverage provisions in conformity with IAEA doc. GOV/1621. However, suppliers undertake to strive for the earliest possible implementation of the policy referred to in paragraph 4 (a) under such agreements.
 - (e) Suppliers reserve the right to apply additional conditions of supply as a matter of national policy.
5. Suppliers will jointly reconsider their common safeguards requirements, whenever appropriate.

Special controls on sensitive exports

- 6. Suppliers should exercise restraint in the transfer of sensitive facilities, technology and material usable for nuclear weapons or other nuclear explosive devices. If enrichment or reprocessing facilities, equipment or technology are to be transferred, suppliers should encourage recipients to accept, as an alternative to national plants, supplier involvement and/or other appropriate multinational participation in resulting facilities. Suppliers should also promote international (including IAEA) activities concerned with multinational regional fuel cycle centres.

Special controls on export of enrichment facilities, equipment and technology

- 7. For a transfer of an enrichment facility, or technology therefor, the recipient nation should agree that neither the transferred facility, nor any facility based on such technology, will be designed or operated for the production of greater than 20% enriched uranium without the consent of the supplier nation, of which the IAEA should be advised.

Controls on supplied or derived material usable for nuclear weapons or other nuclear explosive devices

- 8. Suppliers should, in order to advance the objectives of these guidelines and to provide opportunities further to reduce the risks of proliferation, include, whenever appropriate and practicable, in agreements on supply of nuclear materials or of facilities which produce material usable for nuclear weapons or other nuclear explosive devices, provisions calling for mutual agreement between the supplier and the recipient on arrangements for reprocessing, storage, alteration, use, transfer or retransfer of any material usable for nuclear weapons or other nuclear explosive devices involved.

Controls on retransfer

- (a) Suppliers should transfer trigger list items or related technology only upon the recipient's assurance that in the case of:
 - (1) retransfer of such items or related technology, or
 - (2) transfer of trigger list items derived from facilities originally transferred by the supplier, or with the help of equipment or technology originally transferred by the supplier;the recipient of the retransfer or transfer will have provided the same assurances as those required by the supplier for the original transfer.
- (b) In addition the supplier's consent should be required for:
 - (1) any retransfer of trigger list items or related technology and any transfer referred to under paragraph 9(a) (2) from any State which does not require full scope safeguards, in accordance with paragraph 4(a) of these Guidelines, as a condition of supply;
 - (2) any retransfer of enrichment, reprocessing or heavy water production facilities, equipment or related technology, and for any transfer of facilities or equipment of the same type derived from items originally transferred by the supplier;
 - (3) any retransfer of heavy water or material usable for nuclear weapons or other nuclear explosive devices.
- (c) To ensure the consent right as defined under paragraph 9(b), government to government assurances will be required for any relevant original transfer.
- (d) Suppliers should consider restraint in the transfer of items and related technology identified in the trigger list if there is a risk of retransfers contrary to the assurances given under paragraph 9(a) and (c) as a result of a failure by the recipient to develop and maintain appropriate, effective national export and transshipment controls, as identified by UNSC Resolution 1540.

Non-proliferation Principle

10. Notwithstanding other provisions of these Guidelines, suppliers should authorize transfer of items or related technology identified in the trigger list only when they are satisfied that the transfers would not contribute to the proliferation of nuclear weapons or other nuclear explosive devices or be diverted to acts of nuclear terrorism.

Implementation

11. Suppliers should have in place legal measures to ensure the effective implementation of the Guidelines, including export licensing regulations, enforcement measures, and penalties for violations.

Supporting Activities

Physical security

12. Suppliers should promote international co-operation in the areas of physical security through the exchange of physical security information, protection of nuclear materials in transit, and recovery of stolen nuclear materials and equipment. Suppliers should promote broadest adherence to the respective international instruments, inter alia, to the Convention on the Physical Protection of Nuclear Material, as well as implementation of INFCIRC/225, as amended from time to time. Suppliers recognize the importance of these activities and other relevant IAEA activities in preventing the proliferation of nuclear weapons and countering the threat of nuclear terrorism.

Support for effective IAEA safeguards

13. Suppliers should make special efforts in support of effective implementation of IAEA safeguards. Suppliers should also support the Agency's efforts to assist Member States in the improvement of their national systems of accounting and control of nuclear material and to increase the technical effectiveness of safeguards.

Similarly, they should make every effort to support the IAEA in increasing further the adequacy of safeguards in the light of technical developments and the rapidly growing number of nuclear facilities, and to support appropriate initiatives aimed at improving the effectiveness of IAEA safeguards.

Trigger list plant design features

14. Suppliers should encourage the designers and makers of trigger list facilities to construct them in such a way as to facilitate the application of safeguards and to enhance physical protection, taking also into consideration the risk of terrorist attacks. Suppliers should promote protection of information on the design of trigger list installations, and stress to recipients the necessity of doing so. Suppliers also recognize the importance of including safety and non-proliferation features in designing and construction of trigger list facilities.

Export Controls

15. Suppliers should, where appropriate, stress to recipients the need to subject transferred trigger list items and related technology and trigger list items derived from facilities originally transferred by the supplier or with the help of equipment or technology originally transferred by the supplier to export controls as outlined in UNSC Resolution 1540. Suppliers are encouraged to offer assistance to recipients to fulfil their respective obligations under UNSC Resolution 1540 where appropriate and feasible.

Consultations

16. (a) Suppliers should maintain contact and consult through regular channels on matters connected with the implementation of these Guidelines.

(b) Suppliers should consult, as each deems appropriate, with other governments concerned on specific sensitive cases, to ensure that any transfer does not contribute to risks of conflict or instability.

- (c) Without prejudice to sub-paragraphs (d) to (f) below:
- In the event that one or more suppliers believe that there has been a violation of supplier/recipient understanding resulting from these Guidelines, particularly in the case of an explosion of a nuclear device, or illegal termination or violation of IAEA safeguards by a recipient, suppliers should consult promptly through diplomatic channels in order to determine and assess the reality and extent of the alleged violation. Suppliers are also encouraged to consult where nuclear material or nuclear fuel cycles activity undeclared to the IAEA or a nuclear explosive activity is revealed.
 - Pending the early outcome of such consultations, suppliers will not act in a manner that could prejudice any measure that may be adopted by other suppliers concerning their current contacts with that recipient. Each supplier should also consider suspending transfers of Trigger List items while consultations under 16(c) are ongoing, pending supplier agreement on an appropriate response.
 - Upon the findings of such consultations, the suppliers, bearing in mind Article XII of the IAEA Statute, should agree on an appropriate response and possible action, which could include the termination of nuclear transfers to that recipient.
- (d) If a recipient is reported by the IAEA to be in breach of its obligation to comply with its safeguards agreement, suppliers should consider the suspension of the transfer of Trigger List items to that State whilst it is under investigation by the IAEA. For the purposes of this paragraph, “breach” refers only to serious breaches of proliferation concern;
- (e) Suppliers support the suspension of transfers of Trigger List items to States that violate their nuclear non-proliferation and safeguards obligations, recognising that the responsibility and authority for such decisions rests with national governments or the United Nations Security Council. In particular, this is applicable in situations where the IAEA Board of Governors takes any of the following actions:
- finds, under Article XII.C of the Statute, that there has been non-compliance in the recipient, or requires a recipient to take specific actions to bring itself into compliance with its safeguards obligations;
 - Decides that the Agency is not able to verify that there has been no diversion of nuclear material required to be safeguarded, including situations where actions taken by a recipient have made the IAEA unable to carry out its safeguards mission in that State.
- An extraordinary Plenary meeting will take place within one month of the Board of Governors’ action, at which suppliers will review the situation, compare national policies and decide on an appropriate response.
- (f) The provisions of subparagraph (e) above do not apply to transfers under paragraph 4 (b) of the Guidelines.
17. Unanimous consent is required for any changes in these Guidelines, including any which might result from the reconsideration mentioned in paragraph 5.

APPENDIX 2

Special Controls on Sensitive Exports

6. Suppliers should exercise a policy of restraint in the transfer of sensitive facilities, equipment, technology and material usable for nuclear weapons or other nuclear explosive devices, especially in cases when a State has on its territory entities that are the object of active NSG Guidelines Part 2 denial notifications from more than one NSG Participating Government.
 - (a) In the context of this policy, suppliers should not authorise the transfer of enrichment and reprocessing facilities, and equipment and technology therefor if the recipient does not meet, at least, all of the following criteria:
 - (i) Is a Party to the Treaty on the Non-Proliferation of Nuclear Weapons and is in full compliance with its obligations under the Treaty;
 - (ii) Has signed, ratified and is implementing a comprehensive safeguards agreement with the IAEA, and has in force an Additional Protocol or has signed, ratified and is implementing a regional arrangement approved by the IAEA which operates to achieve the same objective by providing confidence in the peaceful nature of civilian nuclear programs;
 - (iii) Has not been identified in any report by the IAEA Secretariat to the Board of Governors, including the Safeguards Implementation Report (SIR), as being in breach of its obligations to comply with its safeguards agreement, nor continues to be the subject Board of Governors decisions calling upon it to take additional steps to comply with its safeguards obligations or to build confidence in the peaceful nature of its nuclear programme, nor has been reported by the IAEA Secretariat as a state where the IAEA is currently unable to implement its safeguards agreement. This criterion would not apply in cases where the IAEA Board of Governors or the United Nations Security Council subsequently decides that adequate assurances exist as to the peaceful purposes of the recipient's nuclear programme and its compliance with its safeguards obligations. For the purposes of this paragraph, "breach" refers only to serious breaches of proliferation concern;
 - (iv) Is adhering to the NSG Guidelines and has reported to the Security Council of the United Nations that it is implementing effective export controls as identified by Security Council Resolution 1540;
 - (v) Has concluded an inter-governmental agreement with the supplier including assurances regarding non-explosive use, effective safeguards in perpetuity, and retransfer;
 - (vi) Has made a commitment to the supplier to apply mutually agreed standards of physical protection based on current international guidelines; and

- (vii) Has committed to IAEA safety standards and adheres to accepted international safety conventions.
- (b) In considering whether to authorize such transfers, and having regard to Paragraph 6(8) above, suppliers should exercise vigilance in ensuring that enrichment and reprocessing facilities are intended for peaceful purposes and should consider other factors in the recipient state or states as a group (in the case of multinational centres), such as:
- (i) Whether the recipient has a credible and coherent rationale for pursuing enrichment and reprocessing capability in support of civil nuclear power generation programmes;
 - (ii) Whether the transfer would have a negative impact on the stability and security of the recipient state; and
 - (iii) General conditions of stability and security;
- (c) In accordance with paragraph 16(b) of the Guidelines, prior to beginning transfers of enrichment or reprocessing facilities, equipment, or technology, suppliers should consult with Participating Governments regarding the nonproliferation related terms and conditions applicable to the transfer.
- (d) If enrichment or reprocessing facilities, equipment, or technology are to be transferred, suppliers should encourage recipients to accept, as an alternative to national plants, supplier involvement and or other appropriate multinational participation in resulting facilities. Suppliers should also promote international (including IAEA) activities concerned with multinational regional fuel cycle centres.

Special arrangements for export of enrichment facilities, equipment and technology

7. (a) For a transfer of an enrichment facility, or equipment or technology therefor, suppliers should seek a legally-binding undertaking from the recipient state that neither the transferred facility, nor any facility incorporating such equipment or based on such technology, will be modified or operated for the production of greater than 20% enriched uranium. Suppliers should seek to design and construct such an enrichment facility or equipment therefor so as to preclude, to the greatest extent practicable, the possibility of production of greater than 20% enriched uranium .
- (b) For a transfer of an enrichment facility or equipment based on the following enrichment technologies¹: gaseous diffusion, gas centrifuge, laser enrichment, and EMIS, any of them, held by one or more Participating Governments as of 31 December 2008, supplier should:
- Avoid, as far as practicable, the transfer of specialized design, development and manufacturing technology associated with such items; and
 - Seek from recipients an agreement to accept enrichment equipment, facilities, and technology under conditions that, at a minimum, do not permit or enable replication of the facilities.

Information required for regulatory purposes or to ensure safe installation and operation

of a turnkey facility should be shared to the extent necessary without divulging enabling technology.

- (c) In the event that technologies other than listed in 7(b) or new technologies for uranium enrichment are being developed for commercial deployment or additional Participating Governments pursue the development of existing technologies, prior to deployment of a test loop or other analogous prototype system Participating Governments, or governments involved should propose arrangements in the NSG governing transfers of such technologies, and the NSG should decide on these proposals. Such arrangements should be, at a minimum, equivalent to those in 7(b). Participating Governments may also propose new alternative arrangements relating to control of transfers of enrichment technology to facilitate cooperation on enrichment technology. Furthermore, Participating Governments will review the special arrangements for export of enrichment facilities, equipment and technology every five years beginning in 2013 for the purpose of addressing changes in enrichment technology and commercial practices.
- (d) Suppliers should make special efforts to ensure effective implementation of IAEA safeguards at supplied enrichment facilities, consistent with paragraphs 13 and 14 of the Guidelines. For a transfer of an enrichment facility, the supplier and recipient state should work together to ensure that the design and construction of the transferred facility is implemented in such a way so as to facilitate IAEA safeguards. The supplier and recipient state should consult with the IAEA about such design and construction features at the earliest possible time during the facility design phase, and in any event before construction of the enrichment facility is started. The supplier and recipient state should also work together to assist the recipient state in developing effective nuclear material and facilities protection measures, consistent with paragraphs 12 and 14 of the Guidelines.
- (e) Suppliers should satisfy themselves that recipients have security arrangements in place that are equivalent or superior to their own to protect the facilities and technology from use or transfer inconsistent with the national laws of the receiving state.



Project on Managing the Atom

Belfer Center for Science and International Affairs

Harvard Kennedy School

79 JFK Street; Malbox 134

Cambridge, MA 02138

Phone: 617-495-4219

Email: atom@harvard.edu

Website: <http://managingtheatom.org>

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